MACROECONOMIC CONSEQUENCES OF FARM SUPPORT POLICIES

Andrew B. Stoeckel,
David Vincent, and Sandy Cuthbertson,

Editors

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Edited by Andrew B. Stoeckel, David Vincent,
and Sandy Cuthbertson

Centre for International Economics
Canberra

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Contents

Tables and Figures vii

Preface xi

1. Overview Andrew B. Stoeckel, David Vincent, and Sandy Cuthbertson 1

2. Agricultural Protectionism and the Less Developed Countries: The Relationship between Agricultural Prices, Debt Servicing Capacities, and the Need for Development Aid Thomas Loo and Edward Tower 64

3. Some Economywide Effects of Agricultural Policies in the European Community: A General Equilibrium Study Andrew B. Stoeckel and Jens Breckling 94

4. Effects of Agricultural Trade Liberalization on West Germany's Economy Hugo Dicke, Jürgen B. Donges, Egbert Gerken, and Grant Kirkpatrick 125

5. Domestic Effects of Agricultural Protection in Asian Countries with Special Reference to Korea David Vincent 150

6. Effects of Agricultural Protection in Japan: An Economywide Analysis David Vincent 173

7. Agricultural Policies and the U.S. Federal Budget and U.S. Trade Deficit Andrew Feltenstein 200

8. The Effect of Agricultural Trade Liberalization on the U.S. Economy: Projections to 1991 Sherman Robinson, Maureen Kilkenny, and Irma Adelman 222

9. Economywide Effects of Unilateral Trade and Policy Liberalization in U.S. Agriculture Thomas W. Hertel, Robert L. Thompson, and Marinos E. Tsigas 260

10. The Taxation of Australian Agriculture through Assistance to Australian Manufacturing Peter J. Higgs 293

11. Costs of Agricultural Trade Wars Glenn W. Harrison, E. E. Rutström, and Randall Wigle 330

Index 369

Editors and Contributors 379

Tables and Figures

Tables

1.1 Study at a Glance: Major Effects of Agricultural Trade Liberalization 5
1.2 Efficiency Gains Caused by Liberalization of Selected Commodities, by Country Group, 1985 25
1.3 Basic Data on Developing Countries 26
1.4 Effects of a 10 Percent Increase in World Agricultural Prices 28
1.5 Trade versus Aid 29
1.6 Trends in EC Output, Employment, and Unemployment 32
2.1 Basic Data on Groups of LDCs 68
2.2 General Equilibrium Price Elasticities for Agriculture 74
2.3 Trade versus Aid 75
2.4 Trade versus Aid in the Long and Short Runs with Varying Efficiency of Tax Collection 77
2.5 Effects per Unit of Increased Net Agricultural Exports from LDCs 78
2.6 Income Distribution: Trade versus Aid 79
2.7 The Effects of a 10 Percent Increase in World Agricultural Prices 80
3.1 Reductions in Agricultural Employment in Selected EC Countries between 1973 and 1983 102
3.2 Estimates of Taxpayer and Consumer Transfer Payments to Agriculture in the EC 108
3.3 Exogenous Shocks Used in Simulation Study 109
3.4 EC Aggregate Simulation Results 110
3.5 Country-specific Simulation Results 111
3.6 Inter-EC Transfers 115
3B.1 EC Expenditure by Sector and Economic Category in 1980 120
3B.2 PSEs for Agriculture and Food Processing 120

3B.3 Estimated Relative Size of Agricultural and Food-processing Protection Measures 121
3C.1 Key Behavioral Elasticities 122
4.1 Subsidy Disbursements to the German Agricultural Sector by Source and Reporting 131
4.2 Prices of Selected Agricultural Products in the EC and World Market 132
4.3 Disposable Income (after taxes) of West German Households, 1974–1984 134
4.4 Land Prices and Market Values of Farmland and of Average Farm (selected years) 135
4.5 CAP Prices and Producer Prices in Germany and France, 1960–61, 1983, 1984 137
4.6 General Features of the Protection System, 1980 138
4.7 Allocation of Subsidies by Sector and Use, 1980 139
4.8 Summary of Macroeconomic Simulation Results: Agricultural Liberalization and Full Trade Liberalization 143
4.9 Sector and Commodity Simulation Results of Agricultural Trade Liberalization 144
4.10 Sectoral Development of Foreign Trade Following an Agricultural Trade Liberalization 146
5.1 Importance of Agriculture in Selected Asian Economies 153
5.2 Nominal Rates of Agricultural Protection in East Asia: 1955–1984 157
5.3 Estimates of Rates of Agricultural Assistance in Selected Asian Countries: 1980–1986 158
5.4 Effects of Removing Agricultural Protection 165
6.1 Nominal Rates of Protection in Japan for Selected Agricultural Commodities: 1955–1986 179
6.2 Projections of the Short-to-Medium Term Impact of Removing Agricultural Protection 187
6.3 Projections of the Short-to-Medium Term Impact of a Balanced Increase in Domestic Expenditure 195
7.1 U.S. Macroeconomic Indicators and Agricultural Supports 207
7.2 Base Simulation for 1985–86: Historical Agricultural Subsidies 214
7.3 Counterfactual Simulation for 1985–86: Agricultural Subsidies Eliminated 215
8.1 Sectoral Composition of National Income, Trade Shares, and Elasticities 235
8.2 Annual Growth Rates of Selected Variables 236
8.3 Composition of GNP 237
8.4 Various Price Indices 238
8.5 Real Absorption in 1986, 1991, and Differences from 1991 by Experiment 240
8.6 Agricultural Sector Experiment Results 241
8.7 Nonagricultural Sector Experiment Results 242

8.8 Sector Income: Differences between 1991 and Experiments 244
8.9 Elasticities of Sector Responses to World Agricultural Prices 245
9.1 Change in Selected Prices 271
9.2 Changes in Long-run Commodity Supply and Demand 272
9.3 Distribution of Gains and Losses from Unilateral Liberalization of U.S. Agricultural and Food Policies: Equivalent Variations 275
9B.1 1984 Price Wedges Employed in Equilibrium Data Set 280
9B.2 Net Expenditures at Net Prices 282
9B.3 Estimated Allen Partial Elasticities of Substitution for U.S. Agriculture 284
9B.4 Estimated Demand Elasticities for the Private Domestic Household 288
10.1 Estimates of Assistance Given to Australian Agricultural Commodities 298
10.2 Projections for Some Nominal Aggregates 302
10.3 Macroeconomic Projections 304
10.4 Sectoral Output Projections 307
10.5 Agricultural Output Projections 312
10A.1 Set of Exogenous Variables for the ORANI Simulations 316
10A.2 Nominal Rates of Protection for 1986–87 319
10A.3 Calculation of the Base-period Agricultural Commodity Subsidy Equivalents 321
10A.4 Subsidy Equivalents to the Agricultural Sector 322
10A.5 Exogenous Shocks to “Other Costs” Required to Simulate the Effects of the Removal of the Agricultural Industry Subsidy Equivalents 324
11.1 Two Simple Agricultural Trade Games 335
11.2 Stages of the Agricultural Trade War: Payoffs in National Welfare 340
11.3 Effects of Trade War on GNP and Welfare 342
11.4 Effects of Trade War on Global Production Structure 343
11.5 Effects of Trade War on Structure of Global Agricultural Trade 345
11.6 One Stage of the Agricultural Trade War: Payoffs in Agriculture and Food Production 349
11.7 Effects of the Alternative Trade War on Global Production Structure 350
11.8 Effects of the Alternative Trade War on Structure of Global Agricultural Trade 351
11.9 Effect of EC Production Subsidy on Welfare and Terms of Trade 352
11.10 Effect of EC Production Subsidy on Global Structure of Production 353
11.11 Effect of EC Production Subsidy on Global Structure of Trade 355
11.12 Agricultural Trade Games Based on the Tyers-Anderson Model 360
11A.1 Effects of Trade War on Global Structure of Trade: Change in Trade 361
11A.2 Effects of Trade War on Global Structure of Trade: Percentage Change in Trade 363

Figures

2.1 A Schematic Model of a Representative LDC 72
2.2 The Geometry of a Simple Version of the Model 82
3.1 Sectoral Gross Value Added at Market Prices for Selected EC Countries in 1982 100
3.2 Short-run Real Wage Rigidity and Unemployment 103
3.3 Real Wage Rigidity and Wage Differentials 104
7.1 U.S. Macroeconomic Indicators 208
9.1 Real Flows in the Economy 265
9B.1 Production Structure in the Farm Sectors 285
9B.2 The Land-distributing Sector 285
9B.3 Production Structure in the Prepared Feeds Sectors 286
9B.4 Production Structure in the Nonfarm Sectors 286
11.1 Transparent Negotiation Set: EC and United States 346

Preface

Agricultural protectionism has been a troubling policy problem for many years. The mid-1980s became known as the period of the agricultural trade crisis. Despite the seriousness of the problem and the attention given to it by many researchers, little or virtually no material progress toward solving it has been made.

In April 1987 a group of people assembled from universities, research institutions, and government agencies around the world met in Washington, D.C., to address the central question: Why so little progress? Specifically, the problem was not what should happen to agricultural policy around the world? Everybody knew the answer to that. Rather, the question was, why are these inferior policies enduring despite the weight of evidence that shows they are not working? The answer: not enough public awareness of the real economic costs and benefits of policies. Obviously, the previous research had not convinced policymakers and the public of the need for reform. Why did this previous research fail (judging from the outcome of persisting inferior policies)?

Previous research had been looking in the wrong place. Reformers are likely to be found outside agricultural circles; after all, the nonagricultural groups are paying the price. Agricultural policymakers who have drawn up these policies are, in fact, part of the problem and not the solution.

Thus, an ambitious effort to assess the economywide impacts of agricultural policy was launched. The goals of this project—whose culmination is the collection of papers printed here—were to determine who is paying for the gains to agriculture and to identify those groups who have the greatest interest in reform. It was agreed that greater economic prosperity and enhanced efficiency in the use of resources were the most telling points for the reform of agricultural policy. But to determine the most efficient use of an economy's resources, all uses of those resources must be measured. Surprisingly, there have been very few studies of the full, economywide use of resources and of the contribution that could be made by reallocation of resources.

To redress this deficiency, the team of investigators agreed on detailed research questions and made a commitment to undertake the research necessary to answer them. At a workshop held in San Diego in November 1987, draft papers describing this research were presented and reviewed by participating researchers and invited reviewers. Following this workshop, papers were refereed, revised, and completed by early 1988 before being presented at conferences organized by the Trade Policy Research Centre in London and the American Enterprise Institute in Washington.

The strength of these papers, the questions tackled, and the short space of time in which the work has come together reflects the professionalism and energy of the people involved. It also reflects their judgment of the significance of the issue they chose to tackle together—namely, the seeming inability of individual countries to change bad policies.

The Global Agricultural Trade Study drew on resources from around the world. Grants were provided by the Innovative Agricultural Marketing Program (IAMP) Fund (managed by Austrade) and by the Australian National Farmers' Federation. Various institutions and agencies provided inputs in kind; these include the Kiel Institute of World Economics, the Economics Research Service of the U.S. Department of Agriculture, the Trade Policy Research Centre, and Purdue University.

The project was managed by the Centre for International Economics, a private economic research agency established in Canberra in 1986. Andrew Stoeckel directed the project. It was his earlier work with the Australian Bureau of Agricultural Economics culminating in the influential "Red Book," which helped trigger interest and commitment from the various researchers. In addition to writing the chapters on Japan and Korea, David Vincent interacted with each of the authors throughout the project and drafted much of the overview. Sandy Cuthbertson was responsible for organizing and managing the flow of correspondence around the world.

Besides the country authors and project managers mentioned in the Editors and Contributors a number of people contributed to this project along the way. John Lee, Administrator of the Economic Research Service, U.S. Department of Agriculture, was an active contributor in both workshops and provided wise counsel and support throughout. John Martin of the OECD gave his advice generously and supported the significance of the question tackled. Gordon Rausser of the Council of Economic Advisors provided help and support in getting the project under way. The project was initiated in Australia, and Vince FitzGerald, Ian McLachlan, Geoff Miller, Andrew Robb, Hon. John Dawkins (Minister for Trade), and Hon. John Kerin (Minister for Primary Industry) all made valuable contributions in the developmental stages. Many other people helped, either by reviewing papers or at meetings and workshops. These include Trent Bertrand, Ron Duncan, George Fane, Mike Finger, John Quiggin, Gerald Schluter, Richard Snape, and John Zeitsch. The management and office support tasks were very demanding; in this the contributions of Ann Cameron, Marguerite Carrington, Judy Fenelon, and Faye Blyton were invaluable.

1. Overview

Andrew B. Stoeckel, David Vincent, and
Sandy Cuthbertson

Summary

There is an acute and persistent agricultural trade problem. Everybody knows that. Large costs to national budgets, chronic dependence of export industries on subsidies, and agricultural products wasting away in stockpiles are the visible evidence of policy failure. Yet little reform has occurred. At the Uruguay Round of multilateral trade negotiations, which commenced at Punte del Este in September 1986, the various ministers said the right things — "to halt and reverse protection and to remove distortions to trade." But already these declarations appear to have been cosmetic: so far the words speak louder than the actions.

Why is there so little progress towards the patently better set of policies available to governments? In nearly every case, national objectives for agriculture, whatever they might be, could be achieved by other policies at lower cost. The reason for the lack of reform lies in governments' lack of political will to tackle the issue. Political will changes as the public's perception of the issues changes. *But the evidence of the costs of agricultural policies has not yet convinced people to demand reform from their governments.* The evidence available now is largely based on the assessment of the initial effects of agricultural policies, assessments which tend to focus on what happens in the agricultural sector alone. But protection from agricultural imports and subsidies to agricultural exports result in taxes on other sectors. Surprisingly, there has been little effort to measure these costs to other sectors in an

economywide framework. There has been no attempt to identify the full economywide benefits and costs of agricultural policies.

The troubles with agricultural trade are not an outcome of some unfortunate configuration of world events. They are the consequences of domestic policies. Logically, it is these domestic policies that have to change. In turn, the best way to enhance domestic policy is to appeal to self-interest. This can be done through greater public awareness of the real economic benefits and costs of policies. While virtually all the expert commentators on trade agree on this need for greater policy transparency, only rarely is it provided. This is the starting point for our project.

The studies making up this project show something well known to economists but not to the public at large: just measuring and reporting only the initial effects of a policy can be very misleading. The second-round and indirect effects may be much different, even to the point of reversing initial impressions. Instead of jobs being saved by agricultural protection they are being lost; instead of countries losing from liberalization they would gain. It is only when the second-round and indirect effects are taken into account that protection from imports is shown to be a tax on exports. So large has the sum total of these trade distortions become, distortions which go well past agriculture, that *the macroeconomic performance of countries has been greatly impaired.*

Ten separate studies by researchers around the world—all adopting an economywide view of the effects of agricultural liberalization—are reported in this volume. These studies cover the three largest industrial groupings—the European Community (EC), Japan, and the United States; the developing world considered as six types of economies; Korea as an example of a rapidly industrializing country; and Australia as an example of a country where there are large trade restrictions on sectors other than agriculture. While the orientation of each of these studies is domestic, the possibility that one country's policy might affect the choices of another is examined in a final study of what appears to lead the United States and the EC to engage in an agricultural trade war (table 1.1).

Industrial countries' liberalization of agricultural trade could have a dramatic effect on developing countries. Real incomes could increase by $26 billion. Significantly, classifying the developing world into six representative economies (following definitions of the World Bank), the Loo and Tower study finds that agricultural importing countries could gain from agricultural trade liberalization. There would be terms of trade losses for agricultural

Table 1.1 Study at a Glance: Major Effects of Agriculture Trade Liberalization

Study	Key issue	Main findings
Loo and Tower (developing countries)	Do developing countries (LDCs) gain or lose from industrial country agricultural liberalization?	• $26 billion (1988 dollars) gain to LDCs • $15 billion reduction in foreign aid possible • $17 billion gain to industrial countries from reduced need by LDCs for aid • 2.4 percent per year reduction in LDC external public debt made possible
Dicke et al. (West Germany)	Effects on West German economic performance of removal of agricultural protection	• 850,000 additional jobs • 5 percent increase in foreign trade • 14 percent growth in engineering exports • 3 percent gain in real GDP
Stoeckel & Breckling (4 largest EC countries)	Effects of removing both CAP and national agricultural protection	• About 3 million additional jobs possible • Manufacturing output up by over 1 percent • Manufacturing exports to rest of world up by 5 percent
Vincent (Japan)	Effects on Japan of removing Japanese agricultural protection	• 3 percent rise in export earnings (1.2 trillion yen in 1985) • 2.5 percent rise in real wage (101,000 yen) • 68 percent fall in rural land prices
Vincent (Korea)	Effects on Korea of removing Korean agricultural protection	• 5 percent growth in real wages (250,000 won/worker in 1987) • 12 percent growth in export earnings (4,500 bill. won)
Feltenstein (U.S.)	Effects on U.S. budget and trade deficits of removing U.S. protection	• reduction in budget deficit of $37 billion (1982 dollars) per year • improvement in balance of trade of $42 billion
Robinson et al. (U.S.)	Longer term effects on U.S. economy of removal of U.S. agricultural protection	• $10 billion (1982 dollars) gain in U.S. GNP • $26 billion reduction in budget deficit • $36 billion increase in investment
Hertel et al. (U.S.)	Effects on U.S. economy and structure of U.S. agriculture of removal of U.S. agricultural protection	• $12 billion (1987 dollars) improvement in U.S. manufacturing output • $14 billion gain in U.S. national income • reduced budget outlays of $80,000 per farm job lost • lower food costs of $14,000 per farm job lost

Table 1.1 continued

Study	Key issue	Main findings
Higgs (Australia)	Taxation of Australian agriculture by assistance to Australian manufacturing	• If manufacturing protection removed then 3 percent expansion in wool and crop exports ($A360m in 1988), 3 percent expansion in farm output, 9 percent expansion in net farm income ($A2,300/farm) • If both agricultural and manufacturing protection removed then 30,000 new jobs
Harrison et al. (U.S.-EC-other trade blocks)	Why do big countries seem to fight trade wars rather than liberalize trade for domestic reasons?	• Depends on nature of domestic welfare effects These reflect terms of trade effects (TT) and instrument with which "war" is fought • If large TT then incentives for both U.S. and EC to raise protection, i.e., fight trade war • If small TT then makes no sense to fight

importers but these would be more than offset by improved efficiency of domestic resource use and a reduction in distorting taxes made possible by the real income and revenue increases. These good things would happen largely because, on average, agriculture tends to be taxed in each of the six types of developing economies. The taxed sector uses resources relatively more efficiently than the heavily subsidized industrial sectors. Indeed, one dollar's worth of transfer to developing countries from agricultural liberalization is equal to or better than two dollars' worth of direct foreign aid. *Trade in this case is two times better than aid.*

The gain to developing countries from industrial country liberalization would allow a substantial reduction in their public external debt, which, at present levels, is a problem for the major world banks. Liberalization would allow the poorest countries to reduce their external debt by 5 percent per year.

Developing countries, exporters and importers alike, have a strong interest in full agricultural liberalization. They should therefore get behind the U.S. proposals in the Uruguay Round of trade talks. The results of studies reported here show that *if the industrial world really intends to assist developing countries, it should liberalize agricultural trade.* Not only would world incomes grow, but debt burdens could be significantly reduced. That is, there are other ways to address debt problems of the third world besides debt for equity swaps and the like. Agricultural liberalization by the industrial world would accomplish more now, and in the long run, and should be a point of discussion for bankers, industrialists, and governments. An assessment of the impact of liberalization on developing countries must involve a consideration of what liberalization would do for the efficiency of domestic resource use. Just looking at the terms of trade effects misses the impacts that matter.

The two studies on the European Community—one incorporating the four largest members, the other based on West Germany—show large macroeconomic effects from the Common Agricultural Policy (CAP) and supporting national government programs. These support policies have changed the EC from the world's largest importer of temperate zone agricultural products to the second largest exporter. The main cost has been on manufacturing output and exports and, given the rigidity of real wages in the community, on unemployment.

Manufacturing output is lower in each of the four largest members of the EC—Germany, France, Italy, and the United Kingdom—as a result of agricultural policies. By increasing the cost of living, these policies reduce the competitiveness of manufacturing exports, and jobs are lost. If agriculture was liberalized, output could increase by over 1 percent for manufacturing, a very large sector in the EC. Manufacturing exports to the rest of the world could increase by 5 percent.

Germany is potentially now the single most important force for reform. It is the largest contributor to the CAP, it is the largest economy in the EC, and of late, it has strongly resisted change in agricultural policy. Total public subsidies to German agriculture are now well over 20 billion DM, about 70 percent of the sector's gross value added at domestic prices. Under liberalization, manufacturing sectors, apart from food, expand. For example, net exports of mechanical and electrical engineering would rise by over 12 percent.

The effects of liberalization on employment are large. The EC suffers from high and persistent unemployment. Its experience with unemployment is different from that of Japan and especially the United States, where substantial increases in employment have occurred in recent times. Agricultural liberalization, along with a 10 percent increase in world agricultural prices (assumed to follow liberalization of world agricultural trade), would lead to significant increases in employment: up to 850,000 additional jobs in West Germany, for instance. A reduction in the rate of unemployment from 9 percent to 5 percent could occur. Agricultural liberalization of West Germany alone would have a very big impact—over 500,000 jobs. The results from the German component of the multicountry model suggest that about one million jobs could be gained there from EC agricultural liberalization. These findings on employment depend on the assumption of rigid real wages. It could be argued that some flexibility does exist. But it would be wrong to assume complete real wage flexibility, given the large and persistent unemployment problem in the EC. Even if real wages were somewhat flexible, *unemployment could increase by up to 3 million persons for the EC-10 as a whole* as a consequence of supporting agriculture. This figure is higher than earlier assessments because national government supports to agriculture, which are as large again as those out of the EC budget, have been included in this new set of studies.

Japan is the world's second largest economy and the world's largest importer of agricultural products. Yet it also has the highest barriers to agricultural imports of any OECD country. The Japan study measures the extent to which this protection to domestic agriculture taxes the economic performance of other sectors. The study by Vincent shows that if agricultural protection were removed, manufacturing export earnings would expand by about 3 percent over the short term and manufacturing employment would grow by up to 4 percent in some sectors. In addition, the removal of agricultural protection would result in a rise in average real wages in the Japanese economy by about 2.5 percent, equivalent to over 100,000 yen per worker in 1985. Rural land prices would fall by about 68 percent. The Japan study observes that the tax effect on aggregate export earnings from agricultural protection is as great as, or greater than, the savings on aggregate import expenditures from such protection. Agricultural protection does not explain Japan's trade surplus.

In Korea, as in Japan, manufacturing growth has placed large adjustment pressures on domestic agriculture. The government has attempted to offset this by escalating agricultural protection. The results of the Korean study indicate that, following domestic agricultural liberalization, aggregate exports would increase by about 4,500 billion won in 1987, employment in processing and manufacturing sectors would increase by about 580,000 jobs, and average real wages would rise by about 250,000 won per worker. Rural land prices would fall by about 40 percent. *In both the Japanese and Korean cases, agricultural support policies amount to a partial undoing of manufacturing industry growth.*

In the first of the U.S. studies, a two-period economywide model is used to investigate the effects on the U.S. budget and trade deficits of elimination of U.S. agricultural subsidies. What this could do to the real rate of interest is important to determining the responses of private savers and investors and hence the outcome for the balance of trade. A multiperiod framework must be used to capture these interest rate effects. The results suggest that the *removal of agricultural subsidies involving direct budgetary savings of $58 billion over 1985 and 1986 would actually have saved $74 billion through its impact on the tax base.* Because net domestic private savings are increased in this scenario, the trade balance improves by more than the value of subsidies eliminated. In 1986 the *elimination of $31 billion of subsidies would have improved the trade balance by $42 billion.* The elimination of agricultural subsidies would therefore make a major contribution towards reducing the current budgetary and trade imbalances in the U.S. economy.

The results of this study illustrate that unless the effects on real interest rates and hence private savings and investment are taken into account, the likely improvement in the trade deficit from agricultural liberalization will be understated.

In the second U.S. study a ten-sector economywide model is used to explore the macroeconomic and sectoral implications of U.S. agricultural trade liberalization over the longer term. The conclusions indicate that U.S. real GNP would increase as would domestic investment and consumption. *The budget deficit would fall and employment and output losses in agriculture would be offset by increased economic activity and employment in manufacturing sectors,* particularly those supplying investment goods.

The third U.S. study considers both the short- and long-term effects on the U.S. economy of a unilateral liberalization of U.S. agricultural policies. A feature of the economywide framework used in this study is its comprehensive treatment of relationships between different parts of U.S. agriculture. The results demonstrate how *U.S. farm programs assist some parts of U.S. agriculture at the expense of other parts*; also, by encouraging excessive use of scarce resources in agriculture, these programs have penalized the economic performance of other sectors. The United States as a whole would be unambiguously better off were it to unilaterally eliminate agricultural subsidies. Gains would accrue in the form of higher nonfarm output, reduced treasury outlays, higher real domestic income, and lower food costs to consumers.

The same study also concludes that the gains from agricultural trade liberalization are large enough to compensate U.S. farmers. This compensation could maintain the farmers' incomes at existing levels without the waste that occurs with current programs.

Agriculture can also be a "taxed" sector in the sense that other sectors, with which it competes for domestic resources, receive more assistance. This is the case for Australian agriculture, which receives relatively low assistance when compared with Australian manufacturing. The Australian study shows that when this taxation effect on agriculture (of assistance to manufacturing) is removed, agricultural output expands by about 3 percent over a two-year period, agricultural exports expand by up to 6 percent, and real net farm incomes improve by about 9 percent or $A2300 per farm in 1988.

The combined effect of the removal of assistance to agriculture and manufacturing is a fall in domestic prices, an improvement in international competitiveness, and an expansion in exports and imports. Real GDP, agricultural output, exports and incomes, aggregate employment, and the net revenue position of the government sector all expand.

The results of the Australian study highlight the pitfalls of using summary measures of agricultural assistance, such as producer subsidy equivalents (PSE), in international trade negotiations. In Australia, New Zealand, and many developing countries where agriculture is taxed relative to manufacturing, reducing agricultural assistance as part of a coordinated cross-country reduction in PSEs would lead to worse outcomes for domestic economic efficiency and real income. To achieve unambiguous gains in domestic economic welfare, assistance reform must begin at home and must apply to all sectors.

The final study in this volume examines the possible interactions of policies in the context of an agricultural trade war between the EC and the United States. In this paper, unlike all the others commissioned, self-interest is not defined independently of the possibility of strategic retaliation by other countries. Game theory is used to predict the outcome in each country, assuming both the United States and EC decide policies on the basis of expectations about each other's behavior.

Whether or not it is in the interests of countries such as the United States and EC to participate in a trade war is seen to depend entirely on the payoff to each that unilateral changes in protection would bring. Assuming that both the EC and United States can significantly influence, by their own actions, world agricultural prices, then both could gain by increasing border protection. Hence, an escalation of a trade war is a likely result. However, the weight of evidence from many studies shows that the payoff from unilateral increases in protection is negative. Certainly the results of all the other studies of this project show significant gains from unilateral liberalization.

Under these circumstances a trade war would indeed be silly. Even so, the original question is valid: the actions of one country, under certain circumstances, could influence the choice of options of another.

In summary, the support to agriculture around the world imposes large costs on OECD economies and developing countries alike. These costs extend well beyond the direct and obvious budgetary cost and transfers from consumers. The reduction in manufacturing output, employment, and exports that occurs in countries heavily subsidizing their agriculture is most significant. A more rational use of resources in both industrial and developing economies would lead to substantial macroeconomic benefits—benefits large enough to have a bearing on contemporary macroeconomic problems such as the large U.S. trade deficit, the high unemployment in Europe, and the international debt problem. *Microeconomic reform is just as important for the health of the world economy as changes in macroeconomic policies.*

The distortions to the agricultural and food processing sectors are now so big that people outside agriculture have a strong interest in agricultural policy reform. Bankers, industrialists, the unemployed, and macroeconomic policymakers—all should share this same strong common interest. The best prospects for agricultural policy reform lie in groups outside agriculture realizing their common interests in substantially changing the political will of governments to reform bad policies. This lack of political will for reform is the stumbling block to a resolution of the agricultural trade problem.

Introduction

Agricultural trade has been one of the most troubling economic issues of the 1980s. Massive interventions by governments using a host of price supports, input subsidies, import taxes, and export subsidies have had adverse, widespread, and often unintended effects. The sum total of these various measures has given rise to rates of effective protection which are among the highest observed for any product anywhere in the world. Disparities in assistance have increased over the 1980s, and in some countries the domestic prices of agricultural goods bear no resemblance to international prices.

There is increasing government and community disquiet as these policies have closed off some markets and led to the disposal of increased subsidized supplies on a smaller international market, with a resulting sharp downward pressure on prices. Trade tensions between countries have intensified as domestic governments have continued to unload surplus agricultural commodities on any market but their own. All of this has involved huge budget outlays for farm support, high consumer taxes on agricultural products, wasteful and distorted methods of production, and equally wasteful and erratic consumption of agricultural goods. There is a growing realization worldwide of the urgent need for governments to get off this agricultural support treadmill.

In the Uruguay Round of trade negotiations, launched in September 1986, agriculture assumed a high priority; all parties made a public commitment to the urgently needed reform. Yet to date there has been little reform: there is simply a lack of political will to act. So one must ask, what determines this political will, and what might change it? The answers to these two questions lie in understanding why the problem arose in the first place and why the current approach to the negotiations is insufficient, on its own, to lead to reform of agricultural policies. These answers form the logic behind this study.

One important explanation for why these policies have been so little reformed (policies which do not achieve all their objectives and which involve unnecessarily high economic costs) is that the net benefits of such reform are not widely appreciated. There has been too little analysis and debate of the economywide benefits and costs of agricultural trade liberalization. Consequently, there is insufficient understanding of what these benefits and costs are, and of who pays and who benefits.

The troubles besetting agricultural trade have little to do with the so-called special nature of agriculture — the problems of climate, disease, technology, the family farm, and the like. Invariably we find that the agricultural trade problem is a direct result of government policies. The domestic policies of individual countries that support (or attempt to support) their agricultural sectors are the root cause of the international trade problem in agriculture. It makes no difference whether the primary motivation for such policies is food self-sufficiency, price stability, or farm income support.

The trade problem is not an outcome of some unfortunate configuration of world events beyond the control of individual countries. It is the consequence of domestic policies. Logically then, to solve the problem domestic policies have to change. These domestic policies are the outcome of demands from domestic groups. Therefore, the logical place to start with any policy reform, including trade policy, is to ensure that the demands of domestic constituents for particular policies are well informed. This study is intended to provide some of that information; it is an economywide assessment of the effects of agricultural policy distortions in the major producing and consuming countries of the world. The focus is on who pays and who benefits.

Given this almost self-evident need to have, as a precondition for reform, a sound understanding of what is truly in the national interest, it is surprising that so few studies of the effects of agricultural policies have measured their full economywide effects. It is well known that help given to one sector is a tax on some other sector or sectors. But some of the more recent and influential studies in agricultural protection, such as the 1986 World Development Report (World Bank 1986) and the Organization for Economic Cooperation and Development Trade Mandate Study (OECD 1987), do not measure resource effects outside agriculture. These are the effects that matter and which, if understood, would be likely to have the greatest influence in securing a change in policy.[1]

For policy improvements to occur, domestic policymakers must be convinced that the gains which would accrue domestically are sufficiently large to warrant the effort of change. Because these gains would occur economywide they cannot be captured by studying only the agricultural sector. If, for example, Japan were to liberalize its beef trade, countries selling more beef to Japan would end up spending a larger share of their gains on manufactured products such as Japanese motor vehicles. The gain to Japan would be the resource shift out of agriculture and into manufacturing exports. To capture such effects the approach adopted in this study is to use full economywide analysis incorporating both agricultural and nonagricultural sectors. The linkages between sectors in each economy are identified and measured in order to identify the groups who pay for support to high cost sectors such as agriculture, and the size of the tax they and all domestic residents bear in terms of diminished economic performance.

The insight that assistance to one sector must inevitably be paid for by another is not new; it has been well recognized by economists for years and even by interest groups outside agriculture. For example, the Japanese business group, the Keidanren (1987), has called for the reform of Japanese rice policies. It is worth noting that the stance adopted by the Keidanren in calling for these reforms does not reflect a response to any outside pressure; rather, it is a call based on domestic considerations. For Japan or for any other country the choice is simple—to liberalize or not.

This study poses the following question: What are the domestic economywide effects of agricultural liberalization? This domestic focus is emphasized for several reasons. First, governments have control over, or are responsible for, their own domestic policies. Second, such domestic policies are the cause of the trade problem. Third, change will happen only with informed public support. Fourth, a government can change only its own domestic policies or, conversely, domestic policies cannot be changed from outside.

The question posed is not of the form, What would the world look like if all countries liberalized their agricultural sectors? This question is frequently put, and understandably so; but its logic is uncomfortable in a number of ways. As noted above, policies are not made at the world level; rather, policies are made by national governments. Also, while it may be accepted that if *all* countries liberalized *all* trade in *all* goods there would be substantial gains, if there is little chance of this happening, then it is what happens at the domestic level on a unilateral basis that matters. If there are gains to be had from domestic reform, albeit smaller gains than would eventuate if agricultural policies were liberalized on a multilateral basis, then not to take those gains is truly to forego the good while waiting for the best.

This "foregoing of the good" appears to be what many countries have done. Perhaps this is because of an unduly optimistic belief in the likelihood of all countries liberalizing trade at the same time. Perhaps, also, blaming other countries, or at least shifting the onus of decision onto other countries, is a convenient way for governments to avoid taking steps which, although generally beneficial, would be disruptive and politically uncomfortable in the short run.

The corruption of the proposition that "liberal (free) trade is the best policy for all countries" to the flawed proposition that "liberal (free) trade is a good policy only if all countries practice it" (Tumlir 1983) is a victory for vested interests over informed public understanding of the gains from trade. So complete has this victory been that much of any trade negotiator's brief is about gaining access to other countries' markets and at the same time "giving away" as little access as possible, i.e., doing nothing about domestic trade barriers. For negotiations between countries to succeed, each participant needs to be backed by widespread public conviction about the benefits of reform.

To deal with the basic question posed by this study, a series of papers on the economywide effects of removing agricultural protection in selected countries was commissioned. The work was undertaken by economic analysts in these countries who were chosen for their technical expertise in economywide analysis, their experience in applying such analysis to economic policy problems, and their interest in, and support for the importance of, the basic question. At various stages of the project, leading policy economists from throughout the world provided valuable support and encouragement to the more technical economic researchers. Although the commissioned analysts were to address a policy issue which has its genesis in agricultural policy, they were not necessarily specialized agricultural economists. This is in keeping with the study's basic emphasis on the domestic economywide implications of agricultural policies rather than the more narrowly based agricultural economic effects.

All but one of the commissioned studies focus on the domestic effects of agricultural protection in individual countries. They include studies of the major players in the agricultural protection debate: the United States, Japan, the EC, and West Germany. The emphasis given to the United States (three commissioned studies) reflects the importance of U.S. agriculture in world commodity markets, the high degree of U.S. government support for domestic agriculture, and the on-budget nature of much of that support and, hence, potential effects via the U.S. budget deficit on trade imbalances in the world economy.

The inclusion of the European Community is important in a number of respects. First, under the EC's Common Agricultural Policy (CAP), agricultural protection in member countries has increased rapidly. The production response by EC farms to producer prices, which are generally well in excess of world prices, has turned the EC from a net importer to a large net exporter of temperate zone agricultural products.[2] Second, the EC has a massive problem of structural unemployment. To create enough jobs to employ the available work force is the greatest economic challenge facing EC governments. The causes of the very high rates of unemployment in EC countries are complex. Institutional rigidities in the labor market, particularly inflexible real wages, are commonly asserted to be an important contributing factor. In economies where real wages are rigid, policies such as agricultural protection, which distort domestic prices, can—via their effects on the growth rate of consumer prices (and hence nominal wages) and the efficiency with which resources are used—exert a big influence on the demand for labor at a given real wage and, hence, the rate of unemployment and rate of economic growth.

West Germany is the economic powerhouse of the EC. It provides significant protection for its agricultural sector over and above that provided under the CAP. Within the EC, opposition to a reform of the CAP appears to be strongest in West Germany, both within government circles and among the domestic farm population. Conversely, within the EC it is in West Germany where the gains from domestic agricultural liberalization are likely to be the greatest.

The inclusion of a study on the effects of agricultural protection in Japan reflects the present dominance of that country in world trading performance, the extremely high protection provided to its agricultural sector, and, notwithstanding this, Japan's role as the world's largest importer of agricultural products. A study of agricultural protection in Korea is also included. In this country there have been large adjustment pressures on domestic agriculture imposed by a strategy of rapid export-led manufacturing growth. The government has attempted to offset these pressures by providing ever increasing assistance to agriculture. This policy has been at considerable cost to the Korean economy. The Korean example is repeated in a number of Asian countries that are following similar manufacturing export growth strategies.

The effects of agricultural protection on developing countries is assessed in a separate study. Developing countries are classified into six types. A generalized approach is used to tackle the question of what would happen to developing countries with agricultural trade liberalization by the industrial countries. One view has been that developing countries would lose as a result of agricultural trade liberalization. This conclusion is based on the fact that developing countries, as a whole, are net importers of temperate zone products, the world prices of which can be expected to rise following liberalization. However, this conclusion does not take into account linkages between agriculture and other domestic sectors, the different efficiencies of resource use in these sectors, and the extent to which domestic industry policies in developing countries tax or subsidize agriculture relative to other sectors. The analysis in the paper on developing countries points to economywide gains through more efficient resource use in developing countries following agricultural trade liberalization in industrial countries.

A common feature of the United States, EC, West Germany, Japan, and Korean studies is that in all these countries domestic industry policies discriminate in favor of agriculture. For balance, a study on what would happen when the assistance to agriculture is less than that provided other sectors is included. That is, what happens when domestic industry policies discriminate *against* agriculture? Australia provides a case in point: assistance to Australian agriculture is considerably less than assistance provided to Australian manufacturing. The analysis for Australia illustrates some of the pitfalls of trying to secure agricultural policy reform by programs that focus on just one sector and which require all participating countries to reduce assistance to that sector in the same manner. As an example, the proposal to get agricultural exporters to agree to reduce assistance—measured by way of a summary measure, such as producer subsidy equivalents (PSEs)—according to an agreed formula, would result in worsened disparities in countries where agriculture is already relatively lightly assisted. The fact that each country is different is one more reason that reform has to start at home.

Notwithstanding the focus of this project on the importance of domestic policy choices, some people believe that actions taken by very large countries like the United States can affect the options available to another country. In this sense the actions of one can influence the actions of another. Hence, a study is included which analyzes some possible welfare implications of an agricultural trade war between two major players—the United States and the EC—and which models the nature of the strategic self-interest of each player. The United States and the EC together dominate world exports of temperate zone agricultural products. They are the most important contributors to the distortions in world food markets. Both have much to gain domestically from the removal of such distortions. The question, then, is whether transparency of the effects of domestic agricultural policies in the case of major players such as the EC and the United States, which may have the power to influence world market prices, is a sufficient condition for unilateral domestic policy reform. Domestic self-interest in one country might need to be tempered by an allowance for the effects of the threat of retaliation by another; although, based on the conclusion of each single country study, the positive payoff from liberalization means that no one gains from a trade war.

Each country researcher was presented with the same objective: to analyze the economic effects in that country of the removal of its agricultural protection and, hence, the economic costs such protection is imposing in that country. The logic of this study emphasizes domestic self-interest—where the effects of domestic agricultural policy reform are measured while regarding world market conditions for agricultural commodities as constant. For this reason no attempt was made to link each country framework and to allow for the feedback effects in individual countries of changes in world agricultural demands. These would be significant under multilateral agricultural protection reform. Some authors also reported results of the domestic effects of multilateral agricultural trade liberalization. In these cases world agricultural commodity price changes—which could follow from multilateral liberalization, as projected by world agricultural commodity market models—have been imposed on the country models.

Nevertheless, an important consideration in a project of this nature is the extent to which the design features of each independent country model, and the nature of the economic environment (model closure) in which the effects of the removal of agricultural protection are studied, should be standardized. Both aspects are of critical importance in shaping the results. Models are designed to make a problem manageable by providing a simple depiction of a complex system. By intent, therefore, all models abstract from reality. To provide useful insights to policymakers, economic models must capture the important features of the system they seek to represent while omitting details that are of only secondary importance. The adequacy of a model cannot, therefore, be divorced from its purpose. Moreover, there is an element of judgment about which features should be captured, and this must come from the experience of the researcher.

The effect of any economic policy change depends on the economic environment in which it is assumed to take place. Of particular importance are assumptions concerning the nature and extent of resource adjustments. Whether labor markets clear; the degree of factor mobility allowed between sectors or between the domestic economy and overseas economies; how changes in an economy's real income due to the removal of agricultural protection are allocated between domestic spending and the foreign account; how changes in domestic spending are allocated between the government sector and the private sector—all are aspects of model closure that shape the results.

One approach could be to standardize the theoretical design of each country model and its closure, thereby ensuring that the same basic set of economic mechanisms will shape the responses in each country. This approach, while attractive in its appeal to consistency and compatibility, was rejected for the present study. There is no point in being consistent if it means being wrong. Instead, country experts were given free rein to choose the model specification and closure that they felt would best represent economic events in that country as well as provide the best illustration, to domestic decision makers, of the effects of agricultural protection and the economic gains likely to accrue from its removal.

The result is a great variety of economywide models and model closures, with authors in different countries choosing to emphasize different aspects of the way in which domestic agricultural policies tax domestic economic performance. Indeed, given the necessity of abstraction from reality in any exercise like this, and the value of scientific repeatability, the diversity of approaches is a strength of the study.

For example, in the chapters focusing on the United States, where most agricultural protection is financed directly from government revenue and where both the budget and trade deficits are large, the net savings position of the government sector and its implications for the trade deficit are given particular emphasis. In countries where rigidities in the labor market are a feature, authors have chosen to emphasize the effects of the removal of agricultural protection on the labor market in terms of jobs created at a constant real wage, rather than predict what real wage would be sustained at full employment. Some authors have chosen to analyze the effects of agricultural trade liberalization in a short-to-medium-term environment in which factor adjustments are only partial. The results register as a set of adjustment pressures in various sectors. The nature and size of the adjustment pressures likely to be associated with a particular policy reform are always of particular concern to policymakers. Unless these can be shown to be manageable, prospects for the implementation of reform are bleak, no matter what the projected long-term gains. Others have adopted a long-term stance in which complete mobility of factors of production is allowed for.

It is important to note that all of the economic models used incorporate only the static or allocative gains from the removal of domestic policy distortions. These arise from a more efficient allocation of factors of production across domestic activities where production techniques in each sector remain unchanged.

Economists also emphasize the dynamic gains from better domestic industry policies. These arise from the rationalization of production techniques, changes in the structure of firms within industries, and so on, and are induced through greater exposure to international competition. These dynamic gains are difficult, if not impossible, to model. Yet their existence and great importance is emphasized in case studies. None of the country models attempt to incorporate the dynamic gains. For this reason the aggregate gains as measured from agricultural trade liberalization are likely to underestimate considerably those that could eventuate over the longer term.

This study, then, is about transparency of policy; it is also about identifying the gains (and losses) from agricultural policy reform, measuring how big they are, and determining where they would fall. This logic has been endorsed many times. As long ago as 1958, a special report to the General Agreement on Tariffs and Trade (GATT) proposed measurement and analysis as a first step in correcting the drift to agricultural protectionism (Harberler 1958). The Eminent Persons Committee established by the GATT director-general in 1984 proposed a "protection balance sheet" through which it contended "public support for open trade policies would be fostered" (Leutwiller 1985). And in 1987 a group chaired by Oliver Long (a former director-general of the GATT), and organized by the Trade Policy Research Centre in London, proposed that countries use the opportunity afforded by the Uruguay Round to negotiate an agreement on domestic transparency (Long 1987).

This project is an endorsement and application of that logic. It is one of the first coordinated quantitative studies of the economywide effects of agricultural policy reform. The work demonstrates that the methodology and concepts needed to make policy effects transparent are available; indeed, so rapid have recent developments been that economywide assessment of policy has or will soon become a routine matter. Of course, taking into account the links between sectors involves a number of abstractions and assumptions. We cannot know everything about all sectors in the economy. Even so, seldom are we so badly off for knowledge that it is safer to assume other sectors do not exist. Such an assumption, it should be noted, is implicit in partial equilibrium analysis, such as that which focuses solely on agriculture.

Two messages stand out clearly in this study. First, agricultural policies of industrial countries impose large costs on their own economies—costs to output, employment, and income in other nonagricultural sectors—and a lowering of overall economic growth. Second, contrary to what is currently believed, the agricultural distortions introduced by the industrial countries impose a significant cost on the developing countries as a group. Therefore, liberalizing agricultural trade is probably one of the most important things we could do to improve economic prospects in OECD countries and in the developing world.

How Support for One Sector Is a Tax on Others

To protect one industry is to tax another. Obvious as this point may be to the trade theorist, it is often lost on society at large. How else can we explain the inconsistencies which abound in trade, much of which seem to happen despite policy and not because of it? The mercantilist view that exports are good and imports are bad seems to underpin many trade policies. We seldom see imports directly subsidized or encouraged by government-sponsored promotion campaigns. While it is true that some commodities face export controls, direct taxes and restrictions on imports are the rule. Large subsidies prevail for agricultural exports in the developed world. Ironically, the loop which makes import barriers act as export taxes is seldom closed. Thus, people believe they are doing one thing when the very opposite is happening, a common mistake in analyses of trade protection. "Analyses based only on the initial effects of a policy are likely to prove a misleading, if not downright dangerous, guide to action. . . . this is particularly true of analysis of the consequences of protection against imports" (Clements and Sjaastad 1984).

Imports add to welfare. Imports allow people access to a range of goods and services which would not otherwise be available at the same low cost. To the importing country, they represent goods and services produced by the resources of other countries. But to pay for imports, foreign exchange has to be earned and for this to happen, exports need to be sold on world markets. Thus, the point of exporting is to be able to import. Foreign exchange gained from exports cannot be used domestically. Yet to produce export goods, the exporting country has to use up some of its domestic resources. While it might be nice to save some foreign exchange for future use, to deny its use forever would simply make the foreign exchange worthless; it would be like being marooned on a desert island with a bucket of gold.

How might we explain the apparent gap between public understanding and what logic tells us to be true? Three possible explanations might be considered. One is that the logic is wrong. Second, the "public" is, on balance, too dull-witted to assimilate subtle ideas. Or, third, the information has not been properly presented. We reject the first and second explanations. Nothing has been produced to refute the logic; and "no policy which is to the advantage of the people is incapable of being effectively explained to them" (Hutt 1971). Thus, the explanation must lie in a lack of adequate analysis and in the way the issue has been presented to the public.

Assistance to one sector is a tax on others because all the different parts of an economy are linked together. Several types of links may be identified. First, there are the forward and backward links between producing and consuming sectors. One sector's output or sales is another sector's input or costs, and so on. For example, milk, the output of the farm-based dairy industry, is the input of the "downstream" cheese-making industry. Hence, policies which increase the price of milk impose higher costs on cheese making. These, in turn, are passed on throughout the economy. Higher cheese prices, for example, add to the consumer price index, changes in which are often important in setting other costs and charges throughout the economy, including, perhaps, wages. This in turn means repercussions for many other prices besides cheese prices—for example, the prices of equipment, fertilizers, and so on, which might be inputs into both the production of milk and of cheese.

There are also indirect links which, although more subtle, can be just as important. These exist because all industries operate and compete in an economy which, at various stages, is subject to a number of constraints—constraints on the availability of labor, land, and capital; the balance of payments constraint; the government budget constraint; and so on. For example, if assistance to dairying means that output and employment in dairying expands, then so long as labor is not in excess supply, labor will be bid away from other sectors. For such sectors to retain labor, the wage they offer must be increased, thereby ensuring an initial increase in the economy-wide wage and hence the costs of employing labor to all sectors. This initial increase will not persist and ultimately wages will fall because of the waste of having inefficient sectors expand at the expense of efficient ones.

With a fixed supply of land, higher returns from dairying involve higher returns to dairy land. Other land-using sectors will be disadvantaged in the sense that to remain profitable and keep land producing in these sectors, they must match the return earned by dairy land. In countries where there is strong competition between rural and urban uses of land, higher rural land prices due to agricultural protection means higher costs of residential dwellings, reduced demands for such dwellings, and hence diminished sales prospects for industries supplying residential construction activities with goods and services. And so the story goes on.

Another important means whereby the economic performance of industries is linked, even though such industries may not make sales to one another, is through the balance of payments constraint. That is, in the medium to longer term the extent to which a country can spend more than it earns (or vice versa) depends on the willingness of the rest of the world to lend it foreign exchange (or accept its surplus savings). This opinion of the rest of the world is enforced through changes in the real exchange rate, which measures the differential between domestic production costs and world prices to producers. Consider, for example, subsidies intended to expand agricultural exports. With the operation of an external balance constraint, additional export earnings from agriculture must be matched by reduced export earnings from other sectors and/or increased expenditure on imports. The mechanism enforcing this constraint is an appreciation of the real exchange rate involving either a revaluation of the nominal exchange rate and/or a boost to the rate of domestic inflation in the subsidizing country relative to that in the countries with which it trades. Either way, the result is the same: higher costs relative to prices received for other export- and import-competing sectors, and hence diminished economic performance of such sectors.

As a final example consider the operation of a government budgetary constraint. The amount of spending undertaken by a government is determined largely by the capacity of that government to raise revenue. This in turn reflects the share of national income that society is willing to allow government to control. Increased government spending on agricultural support implies reduced outlays in other areas or increased taxes. Both have differential effects on sector performance.

It is often difficult for individuals to appreciate these linkages because individuals tend to focus on their immediate circumstances. It might be noted that economists in the policy advisory process frequently make the same mistake. Branches of the profession focused on a single sector—agricultural economics, for example—demonstrate this natural tendency. A continuing theme in this report is that an understanding of the effects of agricultural policy cannot come from a single sector view.

The above discussion has sketched out some of the different ways in which assistance to one sector can influence the economic performance of others. The fundamental point is that when industries are given an advantage relative to others they are provided with an incentive to expand (or to reduce the rate of their contraction, which might be imposed by pressures elsewhere in the economy). To expand, the advantaged industries must attract resources from other areas, which usually means an initial bidding up of the price of these resources. There will be a definite price-raising effect for those factors used most intensively in the protected industry. If, however, the expanding industry is relatively less intensive in its use of one factor—as compared with the contracting industry—there will either be a reduction in the price of that factor or a surplus of it. In the studies of agricultural protection in the EC, this effect is seen to be very important. The encouraged sector, agriculture, uses more land and capital per unit of output relative to labor. The contraction of manufacturing means that labor is shed. The result is diminished returns to the factor, labor, which registers as some combination of falling real wages and falling employment.

One factor owner's misfortune, in this case labor, can be another's good luck. By its nature, agriculture uses one factor of production quite intensively —land. With more assistance for agriculture, farmers have an incentive to acquire more land to increase production. But the available land resource is more or less fixed so that excess demand gets built into higher land prices. When this happens most of the benefit of protection accrues to the people lucky or perceptive enough to own land in the first place. That is, agricultural protection redistributes national income away from labor. This effect can be particularly pronounced when land is in relatively short supply (e.g., Japan).

Some of the taxation effects of assistance for one sector on others are a little more obvious. When help for one sector comes directly from the budget, it is easy to appreciate that this budget outlay means another government activity or another sector receives less. Someone has to pay the taxes to raise the budget expenditure in the first place. Taxpayers soon know this and equally soon recognize that they have less to spend themselves. Less easy to appreciate is the fact that when consumers do not spend this money, growth and employment in the areas where it would have been spent suffer. This built-in transparency of budgetary assistance is sometimes seen by governments as a liability. The very fact that budgetary assistance is so visible and obvious has meant that it is the least used form of protection—it is just too obvious. Nearly three-quarters of the assistance given to agriculture in OECD countries is in the form of hidden transfers through distortion of the price mechanism (OECD 1987). The assistance is provided "under the counter" because if it were "up front" it would not be tolerated by the people paying for it.

The challenge for policy analysis is to make these "under the counter" measures visible and transparent. The relevant question to ask of any sectoral policy (including agricultural policy) is, What is the relative gain or loss from using scarce resources in some other way? And only an economywide analysis can portray the effects of sectoral policies.

The study herein of the impact of agricultural protection on the developing countries is a good illustration of this point. We observe that the issue is not just what would happen to the cost of food for developing countries with world agricultural liberalization. Rather, it is what would happen to the efficiency of resource use in developing countries with liberalized agricultural trade. The study concludes, contrary to most considered opinion, that most developing countries would benefit.

An economywide approach also helps refute the notion that bad policies for small sectors do not matter. The agricultural sector of modern industrial economies may account for only 3 to 4 percent of GDP. But protection for agriculture is mostly by way of assistance to the food-processing sector. Agriculture together with downstream food processing typically account for 10 percent of total economic activity.

Moreover, these distortions to agriculture and food processing are among the largest we can observe for any products in any country. Effective rates of protection for agricultural products in the EC can be well over 150 percent, while those for other manufactured products are low or even negative. These disparities in sectoral assistance are among the biggest in the world. With that, the absolute tax and consumer transfers to agriculture are enormous. For example, according to estimates by the OECD (1987), average financial contributions made by taxpayers and consumers in the EC to agriculture over the 1979 to 1981 period amounted to 21 and 36 billion ECU respectively. So assistance for what might have been thought to be a small part of the economy has led to large direct and indirect distortions for up to 10 percent of economic activity. It is intuitively obvious that significant economy-wide repercussions for trade, exchange rates, manufacturing, export sectors, land prices, and labor markets could follow.

The intent of this study is to expose just what the implicit tax of agricultural protectionism is doing to other areas of each economy. As Clements and Sjaastad (1984) note: "It is neither harsh nor inaccurate to characterise protectionism as an implicit, indeed an invisible, conspiracy to beggar one's own exporters. Exporters should be made more generally aware of that disquieting fact."

The remainder of this chapter reveals the major adverse repercussions of agricultural protectionism on many manufacturing export industries, land prices, unemployment levels, and rates of economic growth.

The Impact of Agricultural Protection on Developing Countries

What would agricultural liberalization mean for developing countries? The argument is frequently put that while agricultural protection in the industrial economies increases supplies and reduces world prices, this benefits poorer countries through greater access to larger quantities of cheaper food. An abundance of food and big stockpiles are also taken to be a plus for food security and hence to add to the welfare of the world's consumers of agricultural goods.

These arguments have some validity: many developing countries are large importers of temperate zone food products. Indeed, in 1984, imports by developing countries of these products almost equalled imports of these products by the industrial market economies. But the developing countries are also significant producers and exporters of agricultural products. It is the relative efficiency of this domestic agricultural production and export compared to other sectors that is a critical determinant of the results of the Loo and Tower study. Also important is whether developing countries are net agricultural exporters or importers and, hence, what might happen to their foreign terms of trade under liberalization of agricultural markets.

In the context of agricultural trade, the interaction between the developed and developing world has two dimensions. The first is the effect of liberalization of agricultural markets in industrial countries on developing countries; the second is the effect of developing country liberalization on industrial economies. Since the logic behind the Global Agricultural Trade Study is the importance of domestic self-interest in the industrialized countries, where most of the protection for agriculture occurs, the Loo and Tower study is concerned with the first of these interactions.

The industrial countries have some U.S. $1,200 billion in loans outstanding to the developing countries as a group. World Bank figures indicate a debt service ratio of exports to goods and services of 20 percent. In 1987 Citibank wrote down the value of its U.S. $14 billion of developing country loans by 20 percent. Country loans are typically traded in the world market at 70 to 80 percent of their face value. These debt servicing problems and write-offs of bad debts are indicative of the loss of export earnings from these countries. Amongst the developing countries the largest increase in foreign debt burden over the mid-1980s has occurred in the category of agricultural exporters. Lower export earnings from oil have also been important in increasing the debt burden on oil-exporting developing countries.

The issue of the impact of agricultural trade liberalization on developing countries has been studied by many researchers. A recent, widely reported study is that by Tyers and Anderson (1986). This work was the foundation for much of the analysis in the 1986 *World Development Report* (World Bank 1986). An update is contained in Tyers and Anderson (1988). The emphasis of this work is on intercommodity and intercountry relationships as they affect agriculture. The approach includes several agricultural commodities, for which the supplies, demands, and net trade are modeled in some detail. But it does not include sectors other than agriculture. The results show that in 1985 world prices would have risen by between 4 percent (coarse grains) and 67

Table 1.2 Efficiency Gains Caused by Liberalization of Selected Commodities, by Country Group, 1985 (billions of 1980 dollars)

Country group	Industrial country liberalization	Developing country liberalization	Industrial and developing country liberalization
Developing countries	−11.8	28.2	18.3
Industrial market economies	48.5	−13.1	−23.1
East European nonmarket economies	−11.1	−10.2	45.9
Worldwide	25.6	4.9	41.1

Note: Data are based on the removal of the rates of protection in effect in 1980–82.
Source: World Bank (1986).

percent (dairy), but would have fallen for some commodities like rice (−8 percent) as a result of agricultural liberalization by all market economies. The net effect would be a rise in world agricultural prices of around 10 percent. According to Tyers and Anderson the net loss to consumers and producers in developing countries from industrial country agricultural liberalization would be about U.S. $12 billion (table 1.2).

The *World Development Report* argues that the proposition that developing countries would lose from industrial country liberalization, as indicated by table 1.2, is misleading for three reasons. First, the coverage is restricted to temperate zone crops, of which developing countries are the main importers. If tropical products are included the results could be substantially different. Second, according to the *World Development Report*, with free trade some countries might in the long run become exporters of temperate zone products. Third, developing countries stand to gain if they liberalize their own agricultural policies along with liberalization in industrial countries.

Some general equilibrium assessments of the impact through to 1995 of abolishing the CAP on real incomes have been made by Burniaux and Waelbroeck (1985). Burniaux and Waelbroeck impose real wage rigidity on their model. They report real income gains in all but one of the nine world regions (the non-EC Mediterranean region). Interestingly, it is the oil exporters and some middle-income developing countries that would experience the greatest gains. According to Winters (1987), the main mechanism seems to be that the dismantling of the CAP would reduce the real price of industrial goods, which in turn has a beneficial effect on the net imports of manufactured goods by these countries.

One of the difficult issues in modeling the developing world is how to simplify the very large number of countries into a manageable group. The

Table 1.3 Basic Data on Developing Countries

Characteristic	Low income[a]	India	Lower middle income	Upper middle income	Oil exporters	Highly indebted countries
GNP per capita ($US 1985)	200	270	820	1850	1060	1410
GDP (U.S. $billion 1985)	146	176	510	930	533	779
Share of GDP (percentage)						
Agriculture	36	31	22	10	17	15
Industry	19	27	32	35	36	33
Net exports of agriculture (percentage of GNP)	3.5	0.4	3.5	2.1	−1.4	2.0
ERP ([b]) (percentage)						
Agriculture						
Domestic	−20	0	0	0	0	0
Export	−40	−5	−30	−20	−33	−31
Industry						
Domestic	100	50	55	25	59	30
Export	0	20	0	0	9	0
External public debt service percentage						
of GDP	2.9	1.0	5.7	5.7	5.9	5.1
of Exports	18.4	9.3	22.9	21.0	25.6	27.8

[a] Other than China and India.
[b] Effective Rate of Protection.

approach adopted by Loo and Tower is to represent the developing world as six different types of economies. That is, they group the developing countries by economic type rather than on a geographical or political basis. The data and classification of economies follow that of the 1987 *World Development Report* (World Bank 1987). Following this classification, the main characteristics of the developing world represented as six "typical" developing economies are shown in table 1.3.

To model the impact of the industrialized world's agricultural protection policies on these six types of developing economies, Loo and Tower specify a four-sector general equilibrium model. Agriculture uses land, imported materials, and services. The industrialized sector uses labor and capital to produce an industrial composite, which, as with agriculture, is used in combination with imported materials to produce an industrial good. This good is both exported and combined with final goods to produce domestic merchandise goods. There is a similar specification for mining, except that deposits are used as input and all production is exported.

The services sector uses labor to produce one nontraded good. Factor proportions are employed on the basis of relative prices.

Labor is not perfectly mobile between the four sectors; it responds to changes in the wage in each sector relative to the average economywide wage. Wage flexibility in aggregate maintains full employment. Agricultural prices are exogenously determined and change only in response to changing industrial country protection levels. Imports are financed by export earnings, plus foreign aid payments (exogenously given), net of debt servicing. The result is that the trade deficit is equal to these foreign aid payments net of debt servicing costs, which equals the government deficit, since all disposable income is spent.

The specification of taxes is important. Taxes are levied on agriculture (domestic and export), imports and exports of the industrial good, and final consumption except services. The base taxation reflects the latest information on the level of effective protection. As shown in table 1.3, agriculture is the sector that is taxed most heavily in developing countries. To reflect the efficiency losses that occur from raising taxes, Loo and Tower introduce measures of the marginal welfare cost of tax collection. Most estimates for less developed countries (LDCs) of this cost range from 30 to 50 percent. Loo and Tower use 40 percent and conduct some sensitivity analysis. Additional tax revenue from the expanded tax base allows a lowering of the level of distorting taxes. Other closures of the model could be adopted, such as using the extra resources to retire foreign debt. Alternatively, the extra income to developing countries from agricultural liberalization could allow the reduction of foreign aid to these countries.

The above specification means that the effects of agricultural liberalization are driven by three factors. The first is the change in real incomes arising from movements in the terms of trade. The second is the real income gain from the more efficient use of resources in each economy, bearing in mind that the starting point is from a distorted situation. The third is the efficiency gain associated with a less distorted system of taxation.

The efficiency gains occur as follows. Subsidized sectors of an economy waste resources from a social point of view. To save $1.00 of foreign exchange spent on imports by raising protection could cost $1.20 of domestic resources. This simply reflects what almost everyone knows now—protection is inefficient and costly. The taxed sectors of an economy are the efficient sectors. For example, only $0.80 of domestic resources in the taxed sectors, measured at their true social value, may be required to earn $1.00 of foreign exchange. Hence, the more resources are drawn into the efficient,

Table 1.4 Effects of a 10 Percent Increase in World Agricultural Prices

	Country group						
	I	II	III	IV	V	VI	All
Increase in LDC income ($billion 1985)	3.52	2.03	11.4	8.68	8.90	13.4	25.95
Reduction in foreign aid made possible to hold LDC income constant ($billion 1985)	2.86	1.05	6.69	4.22	4.82	7.41	14.82
Income change in developed countries from reduced aid to developing countries made possible by LDC income gain ($billion 1985)	3.55	1.39	7.64	4.00	7.47	8.12	16.58
Annual reduction in external public debt made possible by increased LDC income (percent)	4.82	3.94	3.3	1.27	2.72	2.43	2.38

taxed sectors out of inefficient subsidized sectors, the larger is the real income gain from better resource allocation. An additional factor then operates: to the extent that real incomes and therefore tax revenue rise, there can be a reduction in the level of distorting taxes. This generates further gains as the efficiency loss from raising taxes is reduced. Finally, there is the foreign terms of trade effect, which may add to or subtract from real income, depending on the net trade position with respect to agriculture of the group. The Loo and Tower paper spells out these mechanisms and shows that there could be significant gains from agricultural liberalization for developing countries, gains which are not, in fact, driven by terms of trade effects.

The findings from the Loo and Tower study, showing an increase in world agricultural prices from agricultural trade liberalization, are given in table 1.4. By representing agricultural liberalization as an increase in world prices of 10 percent, the real incomes of developing countries are projected to rise by nearly U.S. $26 billion. This gain could be split between the developed and industrial world in various ways. Holding developing country real income at its initial level, the benefit to the industrial countries from agricultural liberalization—in terms of a reduction in the amount of aid they need to supply and in terms of the beneficial effects on the developing countries alone—would amount to a real income gain of over $16 billion. Alternatively,

Table 1.5 Trade versus Aid

	Country group						
	I	II	III	IV	V	VI	All
Increase in income per unit increase in foreign aid	1.23	1.94	1.75	2.05	1.85	1.79	1.74
Change in income per unit transfer to LDCs via an increase in world agricultural prices	7.87	26.70	6.74	4.55	−12.31	5.95	6.27
Decrease in aid made possible by a unit increase in transfers (holding LDC real income constant)	6.38	13.77	3.85	2.21	—	3.29	3.58
Real income gain to rest of world made possible by a unit increase in transfers (holding LDC real income constant)	7.93	18.23	4.40	2.10	—	3.61	4.02

the developing countries could reduce their external public debt by 2.8 percent on average, but the reduction could be as great as 4.8 percent for the poorest of the developing countries.

All economic groups gain substantially from agricultural liberalization in the industrial world. This is even true of the oil-exporting developing countries, which typically are net agricultural importers and which suffer in terms of trade loss. That is, the gains in efficiency of resource use in agricultural importing countries, combined with the efficiency gains from a reduction of their tax rate, outweigh the terms of trade loss. Also, for India, which according to World Bank data is only a very small net agricultural exporter, the real income gain from agricultural liberalization is over $2 billion.

The relative importance of the different mechanisms operating in the Loo and Tower model can be deduced from the cost-benefit ratios in table 1.5. Four sets of cost-benefit ratios are presented. Row 1 shows the change in LDC real income per unit increase in foreign aid or decrease in debt repayment. A dollar's worth of foreign aid is worth between one and two dollars to the recipient country. In a nondistorted economy this ratio would be equal to one. However, the taxes which raise consumer prices above world levels, and the reduction in distorting taxes made possible by the increased government revenue provided by foreign aid, cause this figure to be above unity in each case. Row 2 is the increase in real income per unit transfer to the LDC through higher agricultural prices. Row 3 is the reduction in foreign aid or increased debt repayment which would be possible per unit increase in the transfer via increased agricultural prices while leaving LDC real income unchanged. It shows that one dollar's worth of transfer via trade liberalization is worth between $2.21 (for a typical upper middle income economy) and $14 (in the case of India) of explicit foreign aid. That is, reducing protection of agricultural goods exported by developing countries is an effective way of assisting LDCs relative to foreign aid. Finally, row 4 shows the increase in real income of the rest of the world that would be made possible, per dollar transferred to each LDC group via higher agricultural prices, if aid or debt repayment were adjusted to leave real income in each group unchanged. This is compiled under the assumption that the marginal welfare cost of tax collection to pay foreign aid or to bail out the banking system is 40 percent. These gains vary from $2.10 up to $18.23 per dollar transferred via higher agricultural prices.

The results support the familiar notion that trade is better than foreign aid, a result which turns out to be robust over varying elasticities and efficiency losses from collecting taxation revenue. It can be seen that one dollar's worth of transfer via trade liberalization in the industrial countries is worth, on average, $3.58 in aid. That is, transferring benefits to developing economies via agricultural liberalization and higher prices is a much better way of supporting those countries than direct foreign aid.

Interestingly, because of the large disparities in effective rates of protection between sectors in developing countries and the distorting taxes that exist, incomes can rise by between $4.55 in upper middle income economies to nearly $27 in a poor country like India from a one dollar transfer to the developing countries via an increase in world prices. As expected, the figure for oil-exporting countries is negative since they are net importers of agricultural goods and suffer terms of trade losses.

This work by Loo and Tower shows that the effects of agricultural liberalization in developing countries extend well beyond the terms of trade effects. Indeed, the positive effects of a more efficient use of resources and a regime of less distorting taxes outweighs the negative terms of trade loss for even the oil-exporting developing economies such as Indonesia. While a more detailed analysis—involving specification of the agricultural sector of the developing economies as temperate or tropical products—would have captured the terms of trade effects in a more precise way, it does appear that these terms of trade effects are in any case relatively minor compared to the potential real income gains likely to arise from more efficient resource use and a less distorted system of taxation in less developed countries.

The implications from this work are profound. They differ from those implied by the quantitative estimates in the 1986 *World Development Report*, which showed a loss to the developing countries from industrial country liberalization. Recall that the *World Development Report* results were derived from a framework which did not include a treatment of the efficiency of resource use between agricultural and nonagricultural sectors. Nor did it take into account the marginal cost of government revenue raising through taxation.

The Loo and Tower results suggest large potential gains to developing countries from agricultural trade liberalization in industrial countries. They imply that the developing countries as a group have a strong vested interest in backing, say, the United States proposal in the Uruguay Round of multilateral trade talks for the removal of all distorting agricultural protection measures over ten years. Moreover, all types of economies, both agricultural exporting and net importing, stand to benefit from trade liberalization, not just the fourteen-country Cairns Group of so-called fair traders and agricultural exporters.

The results also show that the industrial countries could be substantially better off with agricultural liberalization, considering the impact on developing countries. That is, in addition to the gains reported in this project, there is the gain from helping the developing world through enhanced trading opportunities. Moreover, the industrial countries could capture any proportion of this gain they so desire through their own choice of level of foreign aid support for these developing economies.

Finally, other industry groups, such as the major banks with substantial levels of debt outstanding to the developing countries, also have a strong vested interest in agricultural liberalization. Developing countries would find it far easier to service their existing debts and even retire some loans outstanding if the industrial world were to liberalize agricultural trade.

Costs to Employment and Economic Growth in the European Community

Macroeconomic performance in the EC has been poor throughout the 1980s. In particular, member countries have experienced low real growth and a

Table 1.6 Trends in EC Output, Employment, and Unemployment (percent)

	1979	1981	1983	1985	1987
Growth in real GNP					
Germany	4.0	0.0	1.8	2.5	1.9
France	3.3	0.5	0.7	1.4	1.8
Italy	4.9	0.2	−0.2	2.3	2.9
United Kingdom	2.7	−1.4	3.5	3.4	3.0
Growth in employment					
Germany	1.8	−0.6	−1.7	0.8	0.6
France	0.0	−0.6	−0.5	−0.3	0.3
Italy	1.0	0.3	0.3	0.4	0.7
United Kingdom	1.1	−3.7	−1.2	1.0	0.9
Rate of unemployment					
Germany	3.3	4.9	8.2	8.2	7.8
France	6.2	7.7	8.6	10.4	10.8
Italy	7.7	7.9	9.4	10.3	11.2
United Kingdom	5.4	10.1	11.4	11.3	11.2

Source: International Monetary Fund. 1987. World Economic Outlook, April. Washington, D.C.: IMF.

steady rise in the rate of unemployment. This is illustrated in table 1.6. The table shows that the pace of economic growth in these countries over the period has been insufficient, given wage outcomes in the labor market, to absorb the growth in domestic labor supply. The situation in the EC is in stark contrast to that in the United States, where despite only modest output growth the rate of unemployment of the work force has steadily declined.

A number of commentators have drawn attention to increasing rigidities at the macroeconomic level in the EC as a major contributing factor to the region's low growth and high unemployment. Government interventions to shield industries from the adjustments dictated by changing relative prices and hence comparative advantage have lowered the efficiency of factors employed and hence the pace of real income growth. This is particularly true of interventions to support domestic agriculture. In addition, interventions in the labor market, particularly those regulating conditions of employment, have curtailed the flexibility of real wage costs and impeded the adjustment of labor to changing economic circumstances.

For this reason the chapters by Stoeckel and Breckling and by Dicke et al., which study the effects of government assistance to domestic agriculture in the EC and in West Germany, assume a labor market characterized by real wage rigidity. The macroeconomic focus of these papers is therefore on the extent to which domestic agricultural protection has depressed employment, at a constant real wage, and hence has depressed the rate of economic growth and raised the rate of unemployment. The focus at the sector level is on the way in which such protection, working through the various macroeconomic channels discussed earlier, taxes output, income, and employment in other sectors.

Agricultural protection in the EC is provided by both the Common Agricultural Policy (CAP) and national government programs. It is widely recognized that the CAP has reached an impasse. For member governments it has become financially unsustainable at the current high levels of protection. Even with this high protection there is considerable dissatisfaction among community farmers over what they consider to be inadequate incomes. And among the general public there is widespread concern over chronic agricultural production surpluses, agricultural product prices which are well in excess of world prices, and the fact that Eastern European consumers purchase their food products at prices well below those paid by EC consumers. At the international level, the number of trade disputes has increased. These disputes, which are typically about temperate zone agricultural products, import barriers, and the alleged dumping of agricultural surpluses on world markets, are more serious than ever. Finally, antagonism is mounting between member governments over the future direction the CAP should take. Large transfers between member countries are involved.

Taken together these factors highlight what everyone knows: fundamental reform of the CAP and associated national agricultural policies that are based on market principles is long overdue. Yet such reform still meets with stiff opposition in politically influential circles throughout the EC. This is particularly the case in West Germany with the German Farmers Federation. Although leaders in the EC have made many of the "right" statements about the need for more market-oriented farm programs, and some recent changes point in the right direction, the reform, to date, is minimal compared to the changes required.

The Case of West Germany

Agriculture in Germany accounts for less than 2 percent of German gross domestic product and employs about 5 percent of the total labor force. The labor force figure is only 3 percent in terms of full-time equivalents. Agriculture has received large government assistance for decades. Other highly protected sectors in Germany are coal mining, iron and steel, textiles and clothing, aircraft construction, and railways.

Total public subsidies to agriculture now are well over DM 20 billion. This is equivalent to about 70 percent of the sector's gross value added at domestic prices. The number of budget programs directed to the agricultural sector exceeds 400, of which about 100 are run by the EC. It is important to note that about half the subsidies received by German farmers arise from the operation of the CAP. The rest originate with the German government and are under its direct control. In spite of the government's stated commitment to reducing the growth in public spending and industry subsidies, real agricultural outlays continue to increase. In fact, in reaction to recent reductions in agricultural support prices decided by the EC's Council of Agricultural Ministers, the German government has compensated farmers by way of tax relief.

The direct costs of German farm support register through a number of channels. First, there is the financial burden placed on German taxpayers. Second, there is the effect on domestic consumer choice through domestic agricultural prices, which in the early 1980s were on average more than 50 percent above world prices.

Despite this massive transfer from consumers and taxpayers to farmers, various government reports indicate that the income objectives of farmers have not been satisfied. Dicke et al., however, point out that the economic situation of German farmers is much better than asserted for two reasons. First, farm households earn as much income from nonfarm activities as from agricultural production: 40 percent of farms are operated on a part-time basis and those farmers with permanent jobs in other sectors seem to be, on average, better off than full-time farmers. Second, farmers benefit from the increase in land prices induced by agricultural policies.

The analysis by Dicke et al. demonstrates that the effects of German agricultural protection are not confined to farmers, consumers, and taxpayers. German macroeconomic performance and the performance of all sectors of the German economy are influenced significantly. Too much land, labor, and capital is kept in agriculture—resources which could be used with higher productivity elsewhere. In short, the policies hurt German macroeconomic performance and tax Germany's low-cost export industries.

Dicke et al. arrive at this conclusion by estimating the macroeconomic and sectoral effects of the removal of agricultural protection. Their analytical framework is an economywide model of the German economy in which domestic production is divided into thirteen sectors. Numerical results refer to the medium term. The results indicate that agricultural liberalization would increase both skilled and unskilled employment by around 4 percent, which in 1987 terms is equivalent to 850,000 additional jobs. Real gross domestic product would be more than 3 percent higher, relative to the status quo. The stimulus to employment would reduce the rate of unemployment from its 1987 level of around 9 percent to 5 percent. Output would be higher in all sectors except agriculture and food processing. This higher output would be accompanied by an even greater increase in foreign trade (around 5 percent in real terms). That the expansionary effect would fall much more on trade than on output is, according to Dicke et al., an indication of the big welfare gains likely to accrue to the German economy from agricultural liberalization.

Important changes in the commodity composition of trade would occur —away from agricultural products towards the investment goods supplying industry, in which Germany has a distinct comparative advantage. Agriculture and food processing would experience a rise in real net imports (of 65 and 70 percent, respectively), whereas mechanical and electrical engineering would improve their net exports (by 12 and 16 percent, respectively).

The investigators also show that the economywide benefits of policy reform in agriculture could be increased if liberalization were to be extended to other sectors with high protection. If this were to occur, the positive employment effect would be 11 percent (sufficient to offset existing unemployment), output would rise by 9 percent, and there would be a positive foreign trade effect of 26 percent. The increase in the demand for skilled labor could well run up against supply bottlenecks. The ability of the labor market to adjust to accommodate such shortages would determine the extent to which the potential employment gains (of both agricultural and full liberalization) could be realized.

As expected, the big loser from agricultural liberalization would be the agricultural sector itself. Employment and output reductions in agriculture on the order of 24 percent are projected; land rentals would decline by 17 percent, to which one must add a drop in the value of other sector-specific assets such as buildings and livestock. A hypothetical full liberalization would result in even more adverse consequences for agriculture.

Dicke et al. suggest that this likely reduction in asset values is at the root of the German farm community's fierce resistance to the badly needed policy reform. They suggest that in order to overcome this resistance, it may be necessary to compensate farmers financially for these one-off wealth losses. Not only would the German economy as a whole (as well as agricultural export-oriented countries) be better off, but so, also, would German farmers, who would have the incentive to seek employment elsewhere, be it in forestry, industry, or services, in either rural or nonrural areas.

Dicke et al. refer to the suggestion by Professor Herbert Giersch, former president of the Kiel Institute of World Economics, that the government could issue special bonds to be allocated among farmers. Farmers could use the interest income or proceeds from the sale of their bonds however they wished, to continue in the agricultural sector operating at world market prices, or in any other activity. The details of such a scheme are currently under investigation in Germany.

Effects on the European Community

The impact of agricultural protection policies on the EC as a whole has been analyzed by Stoeckel and Breckling. This study is the third in a series of investigations into the economywide impacts of the CAP. The genesis of this research was a simple representation of the EC as one country with four sectors: agriculture, food, other manufacturing, and services (Stoeckel 1985). The resulting suggestion was that one million jobs could have been lost as a result of farm support policies. The significance of this result was sufficient to warrant additional disaggregation to trace through the main impacts that could be operating in member countries.

The second study on the issue, by Breckling, Stoeckel, and Thorpe (1987), disaggregated the European Community into the four largest countries in order to trace the impact on each and the transfers, explicit and implicit, between each economy. In this study, however, the impact of national government supports (excluding social security payments), which are as big as the contribution out of the EC budget, was not considered. The current study by Stoeckel and Breckling reports results with two major additional changes: elasticities that more closely reflect those used in recent partial studies, such as those by Tyers and Anderson (1986), and incorporation of the full range of support measures, at both national and EC levels, as identified by the OECD in its *Trade Mandate Study* (OECD 1987).

The model is a four-country, four-sector Heckscher-Ohlin general equilibrium trade model. It is used to examine the long-run implications of changed policies. All factors are mobile between sectors. However, to represent the high degree of real wage rigidity that exists in the EC, rigid real wages are assumed, as in the Dicke et al. study. Factors of production are not mobile between countries.

Agriculture is modeled as a heterogeneous sector with large-scale and small-scale farms. Agriculture uses family labor, land, and capital, and in addition, large farms use general labor. It is assumed that changes in agricultural protection do not affect the net trade balance of the EC as a whole over the longer term. While this assumption has attracted some criticism from the European parliament secretariat, it is consistent with the observed trend in both exports and imports for the EC as a whole in the past. Note that between EC members net trade need not balance and is matched by transfers between countries.

In the simulations reported by Stoeckel and Breckling all Monetary Compensation Amounts are held constant. The results show a significant impact of the agricultural policies of the Community on the performance of the macroeconomy. As might be expected, the inclusion of national government supports in the simulations of removal of protection results in a larger impact on the Community.

The focus of the study is on the employment consequences from liberalization of agriculture. The findings show that up to four million more people could be employed. This result depends crucially on the assumption of real wage rigidity. In reality, particularly in the long run, there is a degree of flexibility of real wages in the Community. But then, in the long run, real wages are not perfectly flexible either: that is why there is a long-term persistent unemployment problem. Perhaps the best conclusion that can be made is as follows. Unless there is some scientific basis for measuring the extent of real wage rigidity, the losses from the CAP will be taken in the labor market by some combination of lower real wages and higher unemployment. Full wage rigidity may overstate the actual situation, but it would be less correct to assume complete wage flexibility given the serious and persistent unemployment problem. The truth is likely to lie between, say, half and complete real wage rigidity. That would put the jobs lost from agricultural policies at between two to four million with a best guess of three million.

Interestingly, the results for Germany correspond roughly to the results by Dicke et al. Although the two models are not strictly comparable, both show that there are large employment losses from agricultural support in Germany and that manufacturing export sectors pay the price.

The conclusions from the two studies for this project, and from the two studies preceding the Stoeckel and Breckling study, are that agricultural support policies have major repercussions for the macroeconomic performance of the Community. Jobs are *not* saved by agricultural support; they are lost. Moreover, manufacturing competitiveness is impaired and exports of such goods are lower than need be. Economic growth is also lower.

These results have profound implications for the stance of European macropolicy. Take for example one of the contemporary world economic problems—the large U.S. trade deficit matched by trade surpluses, principally in Japan and West Germany. This large global imbalance is seen to be behind the instability of the U.S. dollar, the rising trade tensions between major trading partners, and uncertainty about the future of the world economy.

There have been calls for the surplus countries to stimulate economic growth to generate more imports and reduce their trade surplus. But the West German government has been reluctant to undertake stimulatory fiscal policies to enhance domestic economic growth. Higher economic growth in West Germany would be good, but fiscal stimulus is not the only way to achieve that. This project's two studies on West Germany show quite clearly that liberalization of agriculture would have a positive impact on domestic economic growth. This in turn could assist in correcting the trade imbalance between West Germany and its trading partners.

The conclusion one can draw is that the agricultural policies of the EC impose large and significant costs on the Community—costs in terms of cost competitiveness of manufacturing, lower economic growth, lower manufacturing exports, and higher unemployment than need be. Microeconomic reforms, such as reform of agricultural policy, would give a significant boost to the economies of the Community. The increasing awareness of this fact will gradually involve other groups in the debate about farm policy. Bankers, industrialists, the unemployed, and policymakers outside of agriculture all have a big stake in the progress of reform of the CAP.

The High Cost of Agricultural Protection to Manufacturing Exporters, Nonfarm Consumers, and Wage Earners in Korea and Japan

Countries in the Asian region exhibit considerable differences in government policies towards agriculture. In part this reflects the diversity, among such countries, of agricultural land endowment, stage of economic development, growth strategy being pursued, and sector composition of economic activity and employment. In considering the effects of agricultural protection in Asian countries it is not appropriate to make broad generalizations. A case study approach, which takes into account the features of individual countries, is needed.

Several previous studies have provided estimates of the degree of agricultural protection (measured in terms of Producer Subsidy Equivalents [PSEs] or the extent to which domestic producer prices exceed border prices) in Asian countries.[3] These studies all point to the East Asian countries of Japan, the Republic of Korea (hereafter Korea), and to a lesser extent Taiwan as being those in which agricultural protection is highest and most likely to be imposing significant costs on the performance of other sectors and the economy as a whole. Our Global Agricultural Trade Study has focused on the domestic costs of agricultural protection in two of these countries—Japan and Korea.

The development of agricultural protection in both these countries has some features in common. Both countries have a very low arable land area relative to population.[4] This suggests that products from land intensive agriculture would be unable to compete on world markets with the same products supplied by countries where land is in abundance. Both countries have pursued outward-oriented growth strategies centered around the export of manufactures. This process began in Japan in the mid-1950s and in Korea in the mid-1960s. The result has been spectacular economic growth and living standards. One necessary consequence of this manufacturing-led export growth, however, has been adjustment pressures on domestic agriculture in each country. These pressures have encouraged imports of agricultural products and resulted in a fall in agriculture's share of GDP and employment. In forming industry assistance policies, both governments have given considerable weight to the notions of (1) domestic food security if not food self-sufficiency and (2) equity expressed in terms of parity between farm and nonfarm incomes.

Finally, the policy response of both governments to this manufacturing growth induced reduction in agriculture's comparative advantage has been to attempt to slow the rate of adjustment of agriculture by progressively altering the structure of domestic industry incentives in agriculture's favor—in other words, to partly undo the industrial strategies. This has led to a steady increase in agricultural protection over time to the current very high levels.

This, in turn, has ensured that part of the adjustment, which would otherwise have gone on in the farm sector, has been redistributed to other domestic sectors.

The Cost of Agricultural Protection in Japan

Japan is now the world's second largest economy. It is also the world's largest importer of agricultural products. Yet barriers to agricultural imports in Japan are higher than for any other OECD country. The main instruments of Japanese agricultural protection are expressed as quantitative restrictions against imports and, to a lesser extent, import tariffs and domestic subsidies to farm inputs. As a result of border protection measures, domestic producer prices for Japanese grains in 1986 were on average 420 percent above world prices. The corresponding margin for livestock products averaged 116 percent.

At the international level this high Japanese agricultural protection has several important consequences. First, it is a major source of friction between Japan and her trading partners, particularly agricultural exporters such as the United States and Australia. Pressures from the United States in particular for Japanese agricultural trade liberalization have intensified as Japan's current account surplus has continued to grow hand in hand with the large trade deficits of the United States. Given the substantial share of world economic activity encompassed by Japan and the United States, the threat of retaliatory action, if carried out, has the potential to damage the world trading system.

Second, because Japanese agriculture is heavily protected relative to Japanese manufacturing, such protection, as well as operating to tax agricultural exports to Japan, in effect acts as a subsidy to foreign suppliers of manufactured goods on the world market. The domestic forces opposing agricultural protection reform remain strong. Around 20 percent of Japanese households are farm based, and farmers (many of whom are part-time) are a strong political force.

Nevertheless, domestic interest groups outside agriculture, such as the Keidanren (the Japanese business group) have identified their interests in agricultural protection reform. However, these concerns are still relatively uninformed and what is needed is a better understanding of the domestic effects of Japanese agricultural protection, in particular the extent to which such protection operates as a tax on the economic performance of other sectors of the Japanese economy. The Vincent paper is a substantial contribution to this need.

Using a nineteen-sector economywide model for Japan which incorporates the direct and indirect links between agriculture, other domestic sectors, and international trade, Vincent investigates the short-to-medium term implications for macroeconomic and sector performance of the elimination of border protection and domestic subsidies to Japanese agriculture. The results show that agricultural protection, by raising domestic costs and hence decreasing the purchasing power of a given nominal wage, has significantly reduced the living standards of wage earners.

Increased domestic costs relative to world prices imply reduced international competitiveness of nonagricultural traded activities, especially Japanese manufacturing. The projections show that a major part of the bad news of Japanese agricultural protection is in the form of an implicit tax on Japanese manufacturing, particularly the sectors producing and exporting transport equipment, other machinery, mineral and metal products, and chemical products. This tax is sufficient to curtail manufacturing export earnings by about 3 percent on average, equivalent to about 1.2 trillion yen (in 1985 prices). This leads to reductions in output in these sectors of between 0.3 and 2 percent and reductions in manufacturing employment demand of from 0.4 to 4 percent.

An alternative way of viewing agricultural protection is in terms of its effects in a macroeconomic environment in which (1) the economy's average real wage level is assumed to adjust to ensure constant aggregate employment, and (2) induced changes in aggregate spending are equivalent to induced changes in aggregate income such that the outcome for the balance of trade does not change. In this environment the effects of agricultural protection at the sector level are much the same as those described above. The boost to agricultural output, employment, and income from reduced agricultural import competition is offset by diminished manufacturing export performance and hence a reduction in output, employment, and income in export-oriented manufacturing activities.

Overall, macroeconomic performance is also diminished by agricultural protection even in the short-to-medium term. There is a small reduction in the economy's real income and hence the level of real spending that it can sustain.

The effects on the labor market are startling. The average real wage level in the Japanese economy is reduced by 2.5 percent. This is equivalent to about 101,000 yen per worker in 1985. That is, an important consequence of Japanese agricultural protection is to significantly reallocate a diminished aggregate income away from Japanese wage earners and towards the owners of rural land. The rental price of rural land is raised by about 68 percent by agricultural protection.

In recent years Japan has accumulated a massive surplus of exports over imports. Pressures from the United States, in particular for Japanese agricultural trade liberalization, have intensified as Japan's current account surplus has continued to grow contemporaneously with the continuing large trade deficits of the United States. Notwithstanding the apparent link, it would be wrong, as Vincent points out, to regard Japanese agricultural protection as a contributing factor in this trade surplus.

While Vincent's analysis shows that imports of Japanese agriculture would increase by over 90 percent if domestic protection were removed, Japanese manufacturing export earnings would also increase significantly. In fact, if the labor market gains were appropriated not by higher real wages but by increased employment, then Japan's trade surplus would actually increase. That is, the tax effect on aggregate export earnings from agricultural protection exceeds the savings in aggregate import expenditures from such protection.

The fundamental cause of Japan's current account surplus is low spending relative to income, implying a surplus of domestic savings over that needed by domestic investment at home. Vincent's analysis shows that the removal of this surplus through a balanced increase in domestic spending would have adverse effects on Japanese agriculture. Put another way, the continuation by Japan of a trade surplus is beneficial to Japanese agriculture: if this surplus were eliminated, either Japanese agriculture would contract or, to prevent the contraction taking place, the rate of protection required by Japanese agriculture would need to be increased.

The Cost of Agricultural Protection in Korea

In the case of Korea, government policy towards agriculture had the effect of holding prices to producers below world prices as late as the mid-1960s. Since then discrimination in favor of agriculture, by way of domestic pricing policies supported by border protection measures, has progressively increased to reach extremely high levels. For example, the producer price for domestic agriculture as a whole expressed as a percentage of the corresponding world price at the border has gone from minus 45 percent in 1955 to 30 percent in 1975 and 137 percent in 1984. Over the same period the share of agriculture in GDP has fallen from 45 to 14 percent. This steady increase in protection may be seen as an attempt by the Korean authorities to cushion agriculture from the adjustment pressures imposed on it by rapid manufacturing export growth.

As the chapter by Vincent shows, this policy of discrimination in favor of agriculture has acted as a significant tax on Korean manufacturing, Korean wage earners, and overall Korean macroeconomic performance. This conclusion is drawn from the results of an economywide analysis of effects of removing agricultural protection using a thirteen-sector model of Korea. Sectors distinguished include three types of agriculture (cereals, other crops, livestock), other primary sector activities, downstream food processing, four other types of manufacturing, and three categories of service activities. The results, which refer to a short-to-medium-term adjustment horizon, show that agricultural protection in Korea has substantially reduced the volume of competing agricultural imports into that country. In the absence of such protection, agricultural import volumes would more than double.

This suppression of imports has in turn allowed domestic agricultural producers to raise selling prices and greatly expand their output (by up to 20 percent) and employment (by up to 60 percent), measured against the situation which would have existed in the absence of agricultural protection.

As a result, farm incomes in Korea have been raised significantly—more than 40 percent in real terms for cereals, about 20 percent for producers of other crops, and about 12 percent for producers of livestock. The price of agricultural cropping land has been inflated by about 44 percent in the case of cereals and 25 percent in the case of other crops principally through an escalation in the returns earned by agricultural land. These gains to agriculture have been achieved at considerable cost to other sectors of Korean economic activity. Measured against an economy characterized by an inflexible labor market (with respect to nominal wages), these costs are in the form of a substantial reduction in real wages and in the international competitiveness of Korean export activities. Costs are also reflected, to a lesser extent, in sectors outside agriculture competing for a domestic market share against imports. As a result, exports, output, employment, and incomes in these sectors have been heavily curtailed relative to the situation of no agricultural protection.

Vincent's model projects that if agricultural protection were removed, then, as a result of the deflationary effect on domestic prices, particularly food prices, real wages (CPI deflated) would increase by about 6 percent. This is equivalent to around 277,000 won in 1987 prices. Aggregate export earnings would increase by nearly 9 percent, equivalent to about 3,330 billion won in 1987. Alternatively, the gains to workers from the removal of agricultural protection could be taken in the form of increased jobs at, say, a constant real wage, and not as higher real wages to those currently employed. Another alternative would be a combination of some real wage growth and some growth in employment. Assuming constant real wages, the results indicate that the removal of agricultural protection would provide a boost of more than 8 percent to total employment. This is equivalent to the creation of nearly 1.4 million additional jobs.

Measured against an economy characterized by flexible adjustment of the labor market, the costs of agricultural protection occur in the form of reduced exports, output, and employment in Korean manufacturing and a sizable reduction in the economywide wage level, total labor income, and the share of the national income going to labor. For example, the results suggest that the removal of agricultural protection would lead to a boost to aggregate exports of about 4,500 billion won, increased employment in various processing and manufacturing activities of about 580,000 jobs, and an increase in the average wage level of about 250,000 won per worker in 1987. Rural land prices have been inflated by 40 percent as a result of agricultural protection.

Increasing numbers of Asian economies are moving along the path of economic development followed initially by Japan and subsequently by Korea and Taiwan. This path is characterized by rapidly rising national incomes generated by export-led manufacturing growth, with the resultant adjustment pressures on agriculture being offset by escalating domestic agricultural protection. This suggests that unless the tide against increasing agricultural protection can be turned, the conclusions drawn from the Korean case study are likely to be widely applicable throughout Asia in the near future. Analyses such as this Korean study of the high cost that rapidly rising agricultural protection can impose on wages and manufacturing sectors in rapidly industrializing countries are going to become increasingly important.

Effects of U.S. Agricultural Policies

The United States is the world's largest producer and exporter of food. It also offers many supports to its farm sector, much of it through the federal budget. During the 1980s government expenditure on U.S. farm programs grew rapidly to reach about $30 billion annually. There has been a parallel increase in the deficit of the federal government, which grew from $40 billion in 1979 to $220 billion in 1986. Over this period government outlays on agriculture grew by 182 percent compared with, for example, the much more publicized increase in defense spending of 135 percent.

Clearly, government spending on agricultural support programs is a major factor in the rapid growth of the U.S. budget deficit, a deficit the Reagan administration has been trying to reduce over recent years. The U.S. administration has also tabled proposals in the current GATT round of multilateral trade reductions calling for the complete removal of all agricultural subsidies and import barriers over ten years. The government is therefore maintaining a policy of trying to reduce the federal deficit alongside a policy to remove all farm subsidies and import protection programs. It is therefore fair to ask, What would the removal of agricultural support do for the U.S. domestic budget and trade deficits and overall macroeconomic performance? As discussed below, the answers to this question are quite striking: they have profound implications for the world economy and the contemporary issue of large global trade imbalances.

Federal government intervention in U.S. agriculture has a long history. Its current form dates back to the establishment of the Commodity Credit Corporation in 1933. Then price and income support measures were implemented in response to low world prices for agricultural commodities.

A mix of federal and state programs currently assists U.S. agriculture. Some programs distort production incentives, others are intended as pure income transfers. Yet others provide incentives to undertake soil conservation measures. It is the first group of programs—those which distort production incentives and hence trade flows, macroeconomic outcomes, and domestic activity and employment—which are the focus of the commissioned studies.

Production incentives are distorted by a complex system of price and income supports and direct subsidies to agricultural production. They are sustained by border measures—quotas levied against competing imports and subsidies to exports, the latter under the so-called Export Enhancement Program. Taken together, these measures ensure that U.S. domestic producer prices exceed world prices.

These production incentives promote excess agricultural supplies from the United States and place downward pressure on world market prices. While these expansion effects dominate, there are some policies which constrain resource use by farmer beneficiaries. In order to be eligible for deficiency payments and nonrecourse loans, a farmer must take land out of production. This constraint is intended to offset the production-inducing signal provided by high domestic producer prices and thereby limit the government's budgetary exposure.

It is convenient to partition the domestic effects of U.S. agricultural protection into three categories. These are the effects on

1. macroeconomic outcomes, in particular the twin deficits—the U.S. budget deficit and the U.S. trade deficit;
2. the distribution of economic activity and employment between agriculture and other domestic sectors; and
3. the commodity composition of production, income, and employment within the U.S. agricultural sector.

Rather than use one model to capture these aspects, three separate studies on the United States have been used in this project. Hence the partitioning of the domestic effects of U.S. agricultural protection into the three categories mentioned above is for convenience only. Each of the studies uses an economywide framework which simultaneously determines the effects on macroeconomic performance and the structure of economic activity within agriculture and between agriculture and other sectors.

The frameworks, and hence the studies, differ in the degree to which they emphasize the three categories of domestic effects described above and in the nature of the adjustment environment in which the effects of agricultural protection are studied. There are also significant differences in theoretical structure, particularly in terms of the macroeconomic mechanisms included. The different depictions of macroeconomic relationships lead, in turn, to different outcomes for key macroeconomic variables and, via the national income identity, for net trade.

This is evident when comparing the macroeconomic outcomes from the two-period model of Feltenstein with those from the one-period comparative static framework of Robinson et al. In the former, the use of a two-period framework allows Feltenstein to trace the effects of a reduction in the budget deficit, due to the removal of agricultural subsidies, on the allocation by private consumers of their savings from one period to the next. To find what might happen to interest rates, a minimum of two periods must be modeled. This framework, therefore, allows for the response of consumers to changes in real interest rates. Private investment is also interest rate sensitive and could, in this framework, move in the opposite direction to private savings.

By contrast, in the one-period static framework of Robinson et al., investment is savings determined. There is no role for changes in real interest rates to create a wedge between private savings and private investment. As we shall see later, this leads to different projected outcomes for the balance of trade given the removal of agricultural protection.

The Macroeconomic Effects of U.S. Agricultural Protection

The chapter by Feltenstein considers the macroeconomic effects of U.S. agricultural protection, in particular the effects on the budget and trade deficits. Feltenstein's two-period economywide model allows him to track the macroeconomic interactions set in motion by agricultural subsidies and at the same time capture the distortions such subsidies have on the structure of relative prices in the U.S. economy. The model also depicts the effect of U.S. agricultural protection on the allocation of factors of production between agriculture and other sectors.

Feltenstein uses this framework to consider the direct and indirect effects of three types of U.S. agricultural intervention:

1. subsidies on the inputs of value added to production;
2. a trigger price mechanism in which the government guarantees a fixed price for agricultural output; and
3. support to consumers of agricultural products and government spending on land set-asides.

The simple macroeconomic steps following a reduction in agricultural subsidies as incorporated in Feltenstein's model are as follows. The initial impact is to reduce the government's budget deficit. Assuming, as Feltenstein does, that foreign borrowing and domestic bond sales are held constant, this will decrease the rate of growth of monetary expansion and raise the nominal interest rate. In addition, the rate of inflation will decline; the real interest rate therefore increases. In response to the higher real interest rate, consumers increase their savings because future, rather than current, consumption now appears more favorable to them. Accordingly, overall private domestic savings increase.

At the same time, private investors who equate the current cost of borrowing to the future return on capital will want to reduce their investment, since the costs of financing new investment have increased compared to the future returns from that investment. The result: a wedge has been opened up between private savings and private investment.

The key question that Feltenstein uses his model to answer is, How large will be the final improvement in the trade balance following the reduction in the budget deficit achieved by the elimination of agricultural subsidies? Since savings relative to investment increase, the improvement in the balance of trade could be considerably more than the improvement in the budget deficit.

At the same time, removing or reducing spending on agricultural programs, particularly set-asides, will cause the export price index, in which agriculture is an important component, to decline. This happens, according to Feltenstein's model, because the effect of the set-asides outweighs the supply-increasing distortions of higher producer prices. The effect of the decline in the export price index is to increase foreign demand for U.S. agricultural exports. The initial improvement in the trade balance brings about a strengthening of the U.S. dollar, causing imports to increase. On the other hand, the reduction in inflation may have a positive terms of trade effect, assisting export performance. Nevertheless, the final improvement in the trade balance may be somewhat less than the initial impact.

Feltenstein reports the results of an experiment in which he asks, What would have been the outcome for the macroeconomy in 1985 and 1986 in the absence of agricultural supports? The results suggest that the removal of agricultural subsidies, involving direct budgetary savings of $58 billion over the two years, would have actually saved a total of $74 billion through its impact on interest rates and the tax base. The trade balance is projected to improve by more than the value of the elimination of agricultural subsidies. He estimates that for 1986 the elimination of $31 billion of subsidies would bring about an improvement of approximately $42 billion in the trade balance. This improvement stems from the impact of an increase in the real interest rate on domestic savings and investment, as well as a decline in the export price index. The rate of decline in the U.S. dollar exchange rate slows, so that in 1986 the nominal value of the dollar would have been about 18 percent higher.

Feltenstein's conclusion, therefore, is that the elimination of agricultural subsidies would make a major contribution toward reducing the current budgetary and trade imbalances in the U.S. economy. In particular, it would bring about a 30 percent improvement in the trade balance and would contribute significantly toward lessening the downward pressure on the dollar. Moreover, Feltenstein points out that his results may be overly conservative because his model does not incorporate efficiency gains from the elimination of agricultural protection.

Indeed, the work by Loo and Tower on developing countries shows additional savings that could accrue to the U.S. domestic budget. That work, discussed earlier in this chapter, shows that with agricultural liberalization by industrial countries, aid payments to developing countries could be reduced by $14 billion without those countries' real income falling. Total OECD official development assistance to developing countries amounted to over $37 billion in 1986 and the U.S. contributed nearly $10 billion. As Loo and Tower show, one dollar of transfer by agricultural liberalization is worth over two dollars of direct foreign aid. Clearly, substantial additional savings to the U.S. budget besides those of agricultural program reductions could be made without in any way reducing developing country welfare. This being the case, additional reductions in the U.S. trade deficit could be achieved.

Feltenstein's results have significant implications for the large global imbalances between the U.S. and the surplus countries of Japan and West Germany in particular. These imbalances are a source of major tension between the trading partners as well as a source of uncertainty and instability of exchange rates. The results also show that calls for greater international coordination of macroeconomic policy and target zones for exchange rates are not the only ways to resolve these imbalances and difficulties: microeconomic policy reform, such as reducing high protection, can also have a dramatic impact on the economic performance of the major industrial countries. Discussions on agricultural policy and trade policy in general should be on the agendas of the various summit talks between the G-7 nations, along with issues like the need for greater international policy coordination.

There have been several recent studies that attempted to analyze the interaction between fiscal policies and macroeconomic outcomes in the U.S. The most relevant is that by Marris (1985). This study makes a strong connection between the rising budget deficit and increase in U.S. investment demand leading to capital inflows, and the appreciation of the dollar between 1980 and 1985. The Marris model asserted, and rather accurately, that the trade deficits brought about by U.S. budget imbalances would eventually cause a large devaluation of the dollar as the U.S. foreign debt became intolerably large. The model used by Marris, like those used by most other researchers in this field, is aggregated and hence does not directly address sector-specific policies such as agricultural subsidies. More importantly, the domestic interest rate, one of the primary concerns in Feltenstein's framework, is set externally. Hence, unlike the Feltenstein framework, there is no determination of domestic savings based upon current interest rates and the price and income expectations of forward-looking consumers. As the Feltenstein study illustrates, without linking the deficit, interest rates, and savings, the impact of public spending cuts on the trade balance is likely to be underestimated.

The Long-Term Effects of U.S. Trade Liberalization

The study by Robinson et al. uses a ten-sector economywide model of the United States to explore the long-term implications of U.S. agricultural trade liberalization for economic structure and overall macroeconomic performance in that country. As noted above, unlike the Feltenstein model, the Robinson et al. model is static, referring to only one period in time. It does not, therefore, include a treatment of the role of interest rate changes in influencing the savings behavior of consumers and the spending behavior of private investors. The model is first used to provide projections of what the U.S. economy would look like in 1991 from a starting point of 1986, assuming the provisions of the 1985 Farm Bill remain intact over the period. This forms the set of base-run projections against which the effects of a series of agricultural trade liberalization experiments are compared. Underlying these projections are scenarios on macroeconomic developments, the rate of growth of the economy's stock of capital and labor, and the rate of growth of factor productivity.

The study's macroeconomic scenario for the U.S. economy to 1991 is mildly optimistic. It assumes a significant fall in the federal government's budget deficit of $113 billion to $34.5 billion, in 1982 prices. This decline is achieved by subdued growth in real government expenditure relative to income. As the government deficit shrinks so does the foreign trade deficit. The driving force behind this is a devaluation of the real exchange rate. That is, implicit in the forward projections is the notion that the real exchange rate in the United States is determined largely as a result of U.S. policy choice

—in particular the level of spending relative to income—rather than by the policy choices of other countries.

This view is consistent with the analysis of Adelman and Robinson (1987), which showed that over the 1982 to 1986 period macroeconomic policy choices of the U.S. government, leading to a large government deficit and hence trade deficit, were major contributing factors to the big real revaluation of the U.S. dollar observed over that period. Because the real revaluation meant lower returns for U.S. farmers, this triggered the increased demands from agriculture for government assistance.

The projected devaluation to 1991 is in itself favorable to U.S. agriculture. Nevertheless, agriculture's contribution to the economy is projected to decline over the period. Although target prices increase according to the provisions of the 1985 Farm Bill, loan rates are progressively reduced to approach market clearing prices and land set-asides continue to bind. Agricultural assistance measured in producer subsidy equivalent terms is projected to be much higher in 1991 than in 1986, with 75 percent of net income from grains coming from government programs.

This set of projections to 1991 forms the benchmark against which the effects of a series of agricultural trade liberalization experiments are compared. The experiments include the impact of removing each of the separate components of the U.S. farm programs:

1. removal of land set-asides;
2. removal of border protection measures including quotas against imports and export subsidies; and
3. removal of domestic subsidies provided by the target price programs and that part of domestic price support provided by government stock accumulation activities.

Robinson et al. also investigate the effects of complete unilateral liberalization, involving the termination of all subsidy programs (direct price support activities and border protection measures) and the elimination of land use constraints. The results from the complete liberalization experiment project an increase of real GNP of $10 billion (1982 prices). There is a $26 billion reduction in the government budget deficit, mainly as a result of savings from agricultural subsidies no longer paid, and a $36 billion increase in investment. Absorption is $24 billion higher.

Investment demand consists largely of residential construction and demand for machinery and other capital goods. Industries supplying these goods expand output as labor and capital move into the construction and capital goods sectors from agriculture. Sectors directly linked to agriculture are adversely affected.

Assuming no world agricultural price response to U.S. agricultural liberalization, agricultural exports fall and imports increase. This is the main factor behind a projected deterioration in the trade balance needed to accommodate the increased domestic absorption. The government could of course invoke domestic policy instruments to ensure that the rate of increase in domestic absorption was modified, thereby ensuring a more favorable outcome on the foreign account.

As might be expected, the main losers from unilateral agricultural trade liberalization are U.S. farmers. While farm income falls by up to 19 percent, labor and capital move out of agriculture so that farm income per unit of farm labor remaining increases slightly. Robinson et al. use their model to show that the reduction in U.S. farm income would be greatly mitigated if agricultural liberalization in the rest of the world, and hence higher world agricultural commodity prices, are assumed.

It should be noted that the projected decline in agricultural income is considerably less than the savings in government outlays on subsidies. According to Robinson et al., with agricultural distortions removed, it would cost the government only about $5 billion of pure transfers to guarantee the farm sector an income comparable to the 1991 baseline level.

The investigators also point out that if a failure to achieve agricultural trade liberalization should lead to a round of protectionist policies worldwide, the resulting shrinkage of world trade could impair the ability of the United States to achieve macroeconomic balance, with potential adverse consequences for other economies. On these grounds alone the United States should seek agricultural liberalization. However, even unilateral liberalization on the part of the United States would improve real GNP and reduce the budget deficit.

Effects on Economic Structure with Particular Emphasis on the Agricultural Sector

The study by Hertel et al. also considers the effects on the U.S. economy of the unilateral liberalization of U.S. agricultural policies. A feature of their economywide framework not shared by the Feltenstein and Robinson et al.

models is its comprehensive treatment of production and sales relationships within agriculture and in downstream food-processing sectors. Of the forty-four production sectors distinguished, nine are farm based. A further seven are engaged in the processing of farm products. This allows for detailed modeling of the input substitution prospects facing farmers in each sector, and of the interrelationships between farm activities and between farm production and food processing. It also enables the investigators to incorporate a detailed treatment of the various farm subsidy programs.

Hertel et al. use their model to analyze the short- and long-term effects of the removal of U.S. agricultural subsidies. This distinction is in terms of the degree of factor mobility allowed. In the short term both farm and nonfarm labor and capital are assumed to remain in agriculture though they are free to move towards different types of agricultural production. In the long term capital and labor are assumed to be mobile between all sectors of the economy.

The results show that the removal of agricultural subsidies lowers the demand for farm labor and capital and hence the returns earned by these factors. In the long term labor and capital leave agriculture in favor of the higher returns now offered by nonfarm employment. According to this model, a 5.5 percent reduction in the U.S. agricultural labor force would occur as a result of unilateral agricultural liberalization. The stock of farm capital is projected to fall by 14 percent.

The adjustments within agriculture are highly differentiated. Largest output reductions are projected in the sugar and dairy sectors. For some sectors, such as poultry, the projected output reduction is negligible. Output would actually expand in the oil seeds sector. The clear message from these results is that U.S. farm programs operate to assist some parts of agriculture at the expense of other parts.

Hertel et al.'s results also show how U.S. agricultural protection, by encouraging excessive use of scarce resources in agriculture, has penalized the economic performance of nonagricultural sectors, particularly nonfood sectors. For example, production of nonagricultural manufactured goods is projected to be $12 billion higher (in 1987 prices) and production of other services is projected to be $6 billion higher in the longer term as a result of the elimination of agricultural subsidies.

At the aggregate level real net income in the United States is projected to improve by about $14 billion. That is, the United States as a whole would be unambiguously better off were it to eliminate agricultural subsidies unilaterally. In considering this result it is important to note that the framework used by Hertel et al. is a static one and does not include the dynamic efficiency gains likely to follow from the removal of agricultural distortions in the U.S. economy. This is also true of the Robinson et al. framework. For this reason the projected static net income gain from both models is likely to considerably understate the long-term dynamic gain.

The main losers from the removal of agricultural protection are the owners of the fixed factor in agriculture—farmland. Should the U.S. government consider it appropriate to compensate rural land owners for the inevitable losses in farmland values, then as Hertel et al. point out, the net revenue gains to the treasury from the removal of agricultural subsidies provide a more than sufficient source of funds.

A convenient way of summarizing the nonfarm costs of government policies to support U.S. agriculture is in terms of dollars per farm job saved. According to the Hertel et al. analysis, these costs are significant. Measured in 1987 dollars, they are

1. reduced nonfarm output of $107,000 per farm job saved,
2. increased treasury outlays of $80,000 per farm job saved, and
3. lower real domestic income of $28,700 per farm job saved.

Finally, while rural landowners would bear the brunt of a move by the United States to an undistorted agricultural sector, the losses to agriculture as a whole would be much less if other countries were simultaneously to liberalize their farm policies. This is because export prices facing U.S. farmers would improve as excess resources were withdrawn from agricultural production worldwide. This said, the Hertel et al. analysis clearly demonstrates that it is in the interests of the U.S. economy as a whole to move towards a less distorted domestic agricultural sector irrespective of the policy stance adopted towards agriculture by other countries.

The Taxation Effect on Agriculture of Assistance to Other Sectors

A common feature of the agricultural policies of most of the countries studied in detail in this project—the United States, Japan, Korea, West Germany, and other countries in the EC—is that the assistance provided domestic agriculture by such policies is large in absolute terms and large relative to the assistance provided other domestic sectors. The results from these studies have emphasized the extent to which assistance provided agriculture has operated to tax the economic performance of nonagricultural sectors. However, for many countries the reverse is true. Assistance to agriculture is low relative to that provided other sectors. And in some low-income developing countries, agriculture is also taxed directly by government pricing policies which hold producer prices to farmers below world prices.

Australia is an example of a country in which agriculture is taxed indirectly by government industry assistance policies. Measured against the benchmark of an undistorted economy, Australian agriculture is on average lightly assisted. While Australian agriculture does receive some assistance, frequently by way of special domestic marketing schemes, a number of large Australian manufacturing sectors receive much more. Reform in countries with assistance structures like Australia's would require reduction of the (relatively) high manufacturing assistance as a first priority.

Not only is assistance to Australian agriculture low relative to assistance for manufacturing, it is also low relative to assistance to agriculture in other countries. According to the USDA, of the twelve major agricultural-producing countries Australia provides the least assistance, measured in terms of PSEs, to its agricultural sector. This intercountry PSE information has underpinned some proposals for multilateral agricultural liberalization. These proposals have focused on obtaining commitments from cooperating countries to reduce agricultural assistance. The problem with this idea is that for countries like Australia where the main distortion comes from protection to manufacturing, it would mean a worsening of disparities.

The chapter by Higgs dealing with the domestic effects of Australian agricultural and manufacturing policies is revealing in a number of respects. First, by highlighting how assistance provided to one sector is inevitably paid for by a tax on others, it demonstrates the importance to policymakers of a detailed understanding of the net effects of the full range of domestic industry assistance measures. Second, it shows us the potential pitfalls in using intercountry comparisons of summary measures of agricultural assistance (such as PSEs) to draw inferences about appropriate industry policy for a particular country. Third, it provides separate estimates of the effects on Australian economic performance of assistance provided Australian agriculture and assistance provided Australian manufacturing, and evaluates the extent to which the assistance provided agriculture offsets the taxation effects on agriculture of manufacturing assistance.

Regarding how well Australian agriculture performs, both in the Australian economy and in world export markets, the fact that its agriculture is lightly assisted relative to that of other countries is not important, nor is the absolute level of assistance received important; what is important is the level of assistance *relative* to assistance for other sectors of the domestic economy. Higgs's analysis makes this clear. It emphasizes the way in which agriculture is connected to other domestic sectors directly via cost and sales links and indirectly by virtue of the fact that agriculture must compete with other domestic sectors for resources which are subject to an overall constraint. It is through these direct and indirect links that assistance to Australian manufacturing acts to tax domestic agricultural performance and hence the performance of Australian agriculture on world markets.

Using the very detailed ORANI model of the Australian economy, which distinguishes more than 100 industry categories, Higgs finds that removing assistance to agriculture would, after about two years, contract agricultural output by about 2.5 percent. Since agriculture is a significant exporter, total exports are projected to decline. The revenue saved by the government through removing its assistance to agriculture would reduce the public sector borrowing requirement by about 1.6 percent. As a result of this deflation the contraction in agriculture would lead to a small decline in the size of the economy. The international competitiveness of traded sectors is boosted from the fall in domestic prices and costs. This represents a devaluation of the real exchange rate of about 1 percent. The resultant boost to nonagricultural exports partially offsets the decline in agricultural exports. Aggregate imports are projected to decline, due both to the small contraction in the size of the economy and the improvement in competitiveness of the domestic import-competing sectors.

However, agricultural assistance is only one part of Australian industry policy. When Higgs removes the protection to manufacturing, which is mainly in the form of tariffs on competing imports, prices to domestic purchasers of imported goods, which are mainly manufactures, are lowered. This causes a switch toward imports. It also lowers the consumer price index. As wages in Australia are assumed to be fully indexed to the consumer price index (that is, constant real wages—an assumption that derives from the Australian institutionalized wage determination system), the first-round reduction in consumer prices feeds back into wages and hence back into further price reductions. The result is an improvement in the competitiveness of traded activities, which expands exports and tends to partially offset the first-round increase in imports due to tariff elimination and the expansion in the size of the economy. Exports of wool and crops are projected to expand by 3.4

percent, equivalent to about $A356 million Australian in 1988. Exports of livestock products are projected to expand by 6 percent or about $A160 million. There is a small increase in aggregate employment and real GDP, and, mainly as a result of the government's loss of tariff revenue, an increase in the public sector borrowing requirement. Agricultural output is projected to expand by about 3.4 percent. Real farm incomes increase by 9 percent, equivalent to about $A2,300 per farm in 1988.

What then is the combined effect of the removal of assistance to agricultural and manufacturing industries, as should happen as a result of the Uruguay Round? The answer is, a fall in domestic prices, an improvement in international competitiveness, and expansion in both exports and imports. Real aggregate consumption and investment are projected to increase slightly as are real GDP, aggregate employment, and the net revenue position of the government sector. Agriculture and other export and export-related activities are projected to expand. The losers are the protected textiles, clothing and footwear, and motor vehicles sectors. On average, there are small increases in the outputs of nontraded industries.

The clear conclusion from Higgs's study is that despite the positive assistance it receives, Australian agriculture is in a net sense taxed by the higher levels of assistance received by Australian manufacturing. As a result, Australian agriculture is smaller and has a smaller presence in world agricultural markets. Put another way, assistance to Australian manufacturing, by taxing Australian agriculture, is a subsidy to those agricultural producers with which Australia competes on world markets.

It is worth noting that while assistance to some Australian manufacturing industries is too high, the government has recently (April 1988) taken some significant steps to repair this. Moreover, it has taken these steps unilaterally. Transparency in Australia seems to be working, if slowly.

What does this mean for the use of summary measures of agricultural assistance in the context of international trade negotiations? In recent months work by both the OECD and USDA has popularized and promoted the use of summary measures of agricultural assistance, such as that provided by the producer subsidy equivalent, in international trade negotiations. In fact, the current U.S. government proposal calls for the phased elimination of agricultural interventions over a ten-year period, with PSEs used to monitor progress. Such measures take no account of the relative assistance provided a particular sector. Yet it is this which determines the ability of that sector to compete on world markets. In Australia's case, reducing agricultural assistance as part of a coordinated intercountry reduction in PSEs would worsen agriculture's domestic position relative to manufacturing. That is, it would increase the size of the tax on Australian agriculture from assistance to Australian manufacturing. The danger is that this adverse domestic effect might outweigh the benefit to Australia of a less distorted world agricultural market.

The solution is clear. To achieve unambiguous gains in domestic economic welfare, assistance reform must begin at home. To negotiate reductions in assistance to one sector on the basis of concepts such as PSEs, which, as currently calculated do not measure relative domestic assistance, could lead to worse outcomes from the point of view of economic efficiency and real incomes; yet it is the enhancement of these factors which is presumably what the current round of negotiations are all about. Higgs's results show that a unilateral reduction in assistance to Australian manufacturing, or an across-the-board reduction in assistance to both manufacturing and agriculture, provides a sure way of enhancing Australian agriculture's growth prospects and achieving better macroeconomic outcomes for the Australian economy.

Is Domestic Self-Interest Always a Sufficient Condition for Domestic Agricultural Policy Reform?

Results from the previously discussed single country studies show that in each country high protection, be it for agriculture or some other sector, hurts domestic economic performance. It does this by acting as a tax on economic performance of efficient domestic sectors, which retards economic growth, employment, and living standards. The unassailable logic from these single country results is that, on the grounds of their own self-interest alone, individual countries have a powerful incentive to liberalize their domestic agricultural policies or, where high protection to manufacturing is the problem, to liberalize those sectors. This incentive exists irrespective of what other countries might do to protect their own agricultural sectors.

The chapter by Harrison et al. examines the possible interactions of policies. In this study self-interest is not defined independently of the possibility of strategic retaliation by other countries. The starting point for the study is the apparent existence of an agricultural trade war between the EC and the United States. Based on recent behavior, both sides seem prepared to increase their agricultural subsidies to preserve or win back world agricultural market share. Harrison et al. examine the game theoretic aspects of a hypothetically specified agricultural trade war between the EC and the United States and evaluate its potential welfare costs. They use the game theory concept of a Nash Equilibrium to predict the likely outcome if both the United States and the EC each pursues its own self-interest while expecting the other country to do likewise. That is, each country is assumed to select the preferred policy given the policy choice of the other.

The starting point for the trade war analyzed by Harrison et al. is a set of so-called payoff matrices. These show the payoffs, in terms of changes in domestic consumer welfare, to each country for each of the trade strategies assumed to be available.

Harrison et al. use the world general equilibrium trade model of Whalley (1985) to compute the welfare payoffs to each country of each trade strategy adopted. The Whalley model distinguishes production and consumption for broadly defined sectors in each of the major trading blocks and the trade flows between them. The choice of model is critical to the conclusions the authors reach. A feature of the Whalley model is its assignment of low values to trade elasticities. This means that the dominant driving force behind changes in protection in countries on welfare is the operation of terms of trade effects. Built in to the model is the idea that protection-induced changes in imports by the United States and the EC have a strong influence on world import prices. It follows from the large terms of trade effects that the optimal tariffs for some countries might be quite high. That is, such countries stand to gain significantly from increased protection.

Harrison et al. investigate the effects on the United States and the EC of trade strategies involving a series of percentage increases in existing agricultural protection provided by border measures, tariffs, and nontariff barriers. Domestic agricultural subsidies remain unchanged. Each country is assumed to increase agricultural protection via these border instruments against all sources of supply. The Nash Equilibrium of this trade war implies that the EC would increase existing protection by 175 percent for an EC welfare gain of U.S. $1.2 billion (in 1977 dollars), while the United States would increase protection for the U.S. welfare loss of U.S. $0.2 billion. The global effects of this outcome, according to the Whalley model, are slight decreases in welfare and GNP in all countries other than those in the EC.

Why are these results obtained? As noted, it is through the large terms of trade effects built into the Whalley model. By improving their terms of trade sufficiently, the EC is able to gain on balance from the agricultural trade war and the United States is able to cut its losses. Yet much of the economic literature suggests that terms of trade effects and hence the optimal tariff will be quite small. Countries or groups of countries may have appeared to have had some strategic bargaining power at any point in time, but few have been able to apply that power for extended periods.

How robust is this set of results? The answer is that they are highly dependent on the characteristics of the model used to evaluate the welfare payoffs. The authors go on to report sensitivity analysis using payoffs derived from an alternative world trade model, that of Tyers and Anderson (1988). The Tyers and Anderson model differs from the Whalley model in a number of important respects. On the negative side—given the purpose of the present study—it does not model general equilibrium interactions. Hence welfare measures are based on partial equilibrium evaluations of consumer and producer surplus for agriculture only. Nevertheless, it does provide detailed, multilateral coverage of U.S. and EC agricultural interventions and trade interactions between these and other countries. Furthermore, its results have been widely quoted in the agricultural liberalization policy debate.

According to the Tyers and Anderson model, if the United States were to abolish protection unilaterally, there would be a significant welfare gain to the United States (U.S. $3.2 billion in 1985 prices) and a small welfare loss to the EC (U.S. $0.9 billion). If the EC were to liberalize unilaterally, the welfare gain to the EC would be U.S. $8.9 billion with a welfare loss to the United States of U.S. $0.1 billion. That is, unilateral liberalization in both cases would yield positive domestic gains. If both the United States and the EC were to liberalize, welfare would increase by U.S. $7.5 billion in the EC and U.S. $2.7 billion in the United States. Assuming this set of payoffs, the Nash Equilibrium strategy is for both countries to liberalize. The strategy is different if the measure of welfare refers only to agricultural producers.

In contrast, when the Whalley model is used the results show that if the United States were to unilaterally liberalize its border protection measures to agriculture, the United States would suffer a significant welfare loss and the EC would experience a small gain. If the EC were to liberalize unilaterally, then the EC would be a large loser and the United States a small gainer. With such dramatically opposing payoffs from unilateral liberalization it is not surprising that the models yield opposite conclusions.

The results from the Whalley model, and hence the Nash Equilibrium, of a bilateral trade war between the United States and the EC are also sensitive to the protection instrument used. For example, the results differ markedly according to whether border protection measures or domestic producer subsidies are the means used in the trade war. Harrison et al. demonstrate that this is so by analyzing the effects of increased production subsidies to the EC. The EC is projected to suffer a serious welfare loss from subsidies to domestic agriculture, whereas, as noted above, it is projected to enjoy a significant welfare gain when it unilaterally increases agricultural trade restrictions. This result follows from the fact that, in the Whalley model, the production-distorting effects of increases in production subsidies are much stronger than those for unilateral increases in trade restrictions. In particular, the induced terms of trade effects are swamped by the costs of domestic production inefficiencies.

Notes

1. These studies have primarily focused on the effects of agricultural protection in various countries on world agricultural commodity prices. The results of these inquiries, while of undoubted academic interest, are unlikely to influence policymakers in individual countries to reform their agricultural policies. For example, what incentive is provided to the Japanese government to reform beef-importing policies from a knowledge that if all subsidies to beef production and trade around the world were eliminated, then world beef prices would increase by, say, 10 percent?

2. EC exports of butter, milk, and beef now account for 50, 34, and 26 percent, respectively, of world exports in these commodities.

3. See, for example, Tyers and Anderson 1986, U.S. Department of Agriculture 1987, and Walker 1988.

4. Both Korea and Japan are small in terms of land area. Only about 20 percent of the area of Korea and 15 percent of the area of Japan is suitable for cultivation. The population of Korea is 44 million and that of Japan is 120 million.

References

Adelman, I., and S. Robinson. 1987. *Macroeconomic shocks, foreign trade, and structural adjustment: A general equilibrium analysis of the U.S. economy, 1982–1986.* Giannini Foundation Paper no. 839. Berkeley: Department of Agricultural and Resource Economics, Univ. of California.

Breckling, J. A. Stoeckel, and S. Thorpe. 1987. *Effects of EC agricultural policies: A* *general equilibrium approach–initial results.* Canberra: Bureau of Agricultural Economics and Centre for International Economics.

Burniaux, J., and J. Waelbroeck. 1985. The impact of the CAP on developing countries: A general equilibrium analysis. In *Pressure Groups, Policies, and Development: The Private Sector and EEC-Third World Policy,* ed. C. Stevens and J. V. van Themaat, 123–40. London: Hadden and Stoughton.

Clements, K. W., and L. A. Sjaastad. 1984. *How protection taxes exporters.* Thames Essays no. 39. London: Trade Policy Research Centre.

Harbeler, G., ed. 1958. *Trends in international trade: Report by a panel of experts.* Geneva: General Agreement on Tariffs and Trade.

Hutt, W. H. 1971. Politically Impossible . . . ? London: Institute of Economic Affairs.

Keidanren. 1987. *Rice deregulation: A multistage approach.* KKC Brief, Keizai Koho Center, No. 41 (March). Tokyo: Japan Institute for Social and Economic Affairs.

Leutwiller, F., ed. 1985. *Trade policies for a better future: Prospects for action.* Geneva: General Agreement on Tariffs and Trade.

Long, O., chairman. 1987. *Public scrutiny of protection.* A report on policy transparency and trade liberalization by a study group. London: Trade Policy Research Centre.

Marris, S. 1985. *Deficits and the dollar: The world economy at risk.* Policy Analyses in International Economics 14. Washington, D.C.: Institute for International Economics.

Organization for Economic Cooperation and Development. 1987. *National policies and agricultural trade.* Paris: OECD.

Stoeckel, A. 1985. *Intersectoral effects of the CAP: Growth, trade and unemployment.* Bureau of Agricultural Economics Occasional Paper no. 95. Canberra: Australian Government Publishing Service.

Stoeckel, A., and A. Cuthbertson. 1987. *The game plan—Successful strategies for Australian trade.* Canberra: Centre for International Economics.

Tumlir, J. 1983. International economic order and the decline of multilateralism. Paper presented at ACT Economics Society, 23 March, Canberra.

Tyers, R., and K. Anderson. 1986. *Distortions in world food markets: A quantitative assessment.* World Development Report Background Paper. Washington, D.C.: World Bank.

Tyers, R., and K. Anderson. 1988. Liberalising OECD agricultural policies in the Uruguay Round: Effects on trade and welfare. *Journal of Agricultural Economics* 39, no. 2: 197–216.

U.S. Department of Agriculture. 1987. *Government intervention in agriculture: Measurement, evaluation, and implications for trade negotiations.* Washington, D.C.: U.S. Department of Agriculture, Economic Research Service.

Walker, A. 1988. World agricultural trade distortions—Measurement and recent trends. Paper presented at the annual conference of the Australian Agricultural Economics Society, February, Melbourne.

Whalley J. 1985. *Trade liberalization among major world trading areas.* Cambridge, Mass.: MIT Press.

Winters, L. A. 1987. *The economic consequences of agricultural support: A survey.* OECD Economic Studies no. 9 (Autumn): 7–54. Paris.

World Bank. 1986. *World development report.* New York: Oxford Univ. Press.

World Bank. 1987. *World development report.* New York: Oxford Univ. Press.

2. Agricultural Protectionism and the Less Developed Countries: The Relationship between Agricultural Prices, Debt Servicing Capacities, and the Need for Development Aid

Thomas Loo and Edward Tower

Summary

In this chapter we demonstrate that reducing agricultural subsidies and import barriers in the developed world will generate substantial economic gains, which could be shared between developed nations and less developed ones. We model such liberalization as a uniform increase in all agricultural prices. We consider several policy experiments.

First we examine how liberalization and holding foreign aid and debt servicing constant in less developed countries could contribute to raising the standard of living in LDCs. Then we analyze how freeing up such trade could enhance the capacity of less developed countries to service their international debt or substitute for foreign aid. In both cases we find that liberalization tends to raise labor's income and the income share of the agricultural sector in LDCs, a more equitable outcome since rural real wages are generally lower than their nonagricultural counterparts. While foreign aid also tends to raise labor's income share and the income share of agriculture, the effects for foreign aid are considerably weaker than the effects of the same transfer via an increase in agricultural export prices. We find that these comparative income distributional effects, combined with tax policies which typically discriminate against agricultural production in less developed countries, and the efficiency cost of raising government revenue, combine to make agricultural liberalization by developed countries a particularly beneficial policy.

Introduction

Agricultural protectionism is an issue of critical importance to less developed countries. Most LDCs are net exporters of agricultural commodities and have the potential to export considerably more, should developed countries liberalize their agricultural export policies.[1] But the importance of liberalized agricultural markets to LDCs extends beyond a casual glance at the numbers describing their trade and production. Anne Krueger (1983) and the World Bank (1986), among others, document that less developed countries typically tax their agriculture through export taxes and the activities of agricultural marketing boards; they also subsidize their industry through trade, tax, and credit market policies which bestow high effective rates of protection on them. Krueger argues that in addition to imposing an efficiency cost, such policies serve to worsen the income distribution, because the poorest members of LDCs are typically those employed in agriculture.

These observations have important implications for the effects of agricultural policy liberalization by developed countries. They mean that extra earnings of foreign exchange via increased agricultural production is a particularly effective way of generating resources for less developed economies. This is because taxation of the agricultural export sector means that in agriculture, considerably less than a dollar's worth of resources at domestic prices is required to earn a dollar's worth of foreign currency at the margin; whereas the subsidization of industry means that in industry, considerably more than a dollar's worth of resources at domestic prices is required to save a dollar's worth of foreign exchange. Thus, if resources are drawn from industry into agriculture in order to meet increased external demand, for each extra dollar earned considerably less than a dollar's worth of resources needs to be transferred into agriculture, and the transfer of these resources costs the industrial sector considerably less than a dollar of increased industrial imports to make up for the lost domestic production. The result is a considerable increase in foreign exchange earnings, due both to the terms of trade improvement that generated the resource movement as well as to the increase in net foreign exchange earnings at given world prices. Moreover, the rise in both imports of industrial goods and exports of agricultural goods means that government tariff and export tax revenues rise. To the extent that this enhanced revenue enables governments to reduce the level of distorting taxes and/or tariffs, there will be a further gain in economic efficiency, which raises the standard of living. Below, we further develop this argument using a computable general equilibrium model.

This is, of course, only one possible way to close the model, showing the effect of reduced agricultural protectionism in the developed world. Another possibility is to use the additional resources to foster economic growth. Alternatively, the additional resources made available to the economy could be used to service international debt. Or, as yet an additional alternative, the increased standard of living and resources generated internally to fund economic growth could enable the developed world to cut its development aid to LDCs.

To the extent that LDCs use their increased resources to repay debt, failure rates for developed countries' banks will fall. Consequently, fewer banks will need government bailouts. This will restore resources to the developed world. It will also save on the legal resources associated with rescuing failing banks and eliminate some of the deadweight loss associated with the need to use tax revenues, collected via distorting taxes, to rescue failing banks. Similarly, if the resources made available are used to reduce foreign aid, each dollar collected by LDCs, because of additional exports, can reduce the amount of aid needed by more than a dollar. Finally, this aid reduction will reduce the amount of revenue needed in the donor countries and will reduce the deadweight loss due to tax collection in the donor countries.

In the rest of this chapter we show that these points are valid and calculate how important they are.

Dividing Up the Less Developed World

Below we construct and calibrate a model for representative members of six different types of LDC. The grouping reflects the system of aggregation used in the 1987 *World Development Report* (hereinafter WDR). They are described in greater detail in appendix C.

Group I is low-income economies other than China and India. It consists of economies with 1985 GNP per person of $400 or less.

Group II is India.

Group III is lower middle income developing economies. It consists of economies with per person incomes in 1985 between $401 and $1,600.

Group IV is upper middle income developing economies. It consists of economies with per person real incomes in 1985 between $1,600 and $7,500.

Group V is oil-exporting developing economies. It consists of middle income developing economies with exports of petroleum and gas accounting for 30 percent or more of merchandise exports.

Group VI is highly indebted countries. These are economies which are "deemed to have encountered severe debt servicing difficulties."

Modeling a Representative Less Developed Country

Table 2.1 presents the data used in calibrating our model. All figures except those for effective rates of protection are taken from the 1987 WDR and are designed to describe LDCs in 1985. Figure 2.1 presents the model that describes the structure of each of the economies we consider. We assume four sectors. In each sector constant returns to scale are assumed to prevail, and we assume that the production process is nested, with factor proportions dependent on relative prices. The agricultural sector uses imported materials (Z_a) plus land (T) to produce an agricultural composite (T_z), which is combined with labor services (L_a) to produce agricultural output (A), some of which is exported (A_x) and some of which (A_c) is combined with imports (typically of cereals; C) to produce a composite commodity called food (F), which is consumed domestically. The industrial sector uses labor (L_i) and capital (K) to produce an industrial composite, which in combination with the imported materials (Z_i) is used to produce the industrial good (I), some of which is exported (I_x), and some of which is combined with final good imports (J) to produce a good which we refer to as merchandise (M). The mining and petroleum sector (hereafter oil) uses natural resource endowments, which we refer to as deposits (D), along with labor (L_d) to produce a natural resource composite, which is combined with imported materials (Z_d) to produce oil output (D_x), all of which is exported. Finally, the services sector uses labor to produce services (S), all of which are consumed domestically.

Consumption is also nested with consumption proportions depending on relative prices. Merchandise and food combine to produce a goods composite (G), which is consumed along with services.

Labor is assumed to be homogeneous when measured in efficiency units and is assumed to be imperfectly mobile between agriculture, industry, services, and oil. It is assumed to move between sectors in response to changes in the wage in each sector relative to the average economywide wage. We assume that the elasticity of supply of labor to each sector, except services,

Table 2.1 Basic Data on Groups of LDCs

Group[a]	Taxes on international trade as % of total revenue RTS	Current total revenue as % of GNP R	Effective rate of protection (%)			
			For agriculture		For industry	
			Domestic ERPAD	Export ERPAX	Domestic ERPID	Export ERPIX
I Low income (other than China and India)	29.0	15.6	−20	−40	100	0
II India	24.4	14.0	0	−5	50	20
III Lower middle income	14.3	20.9	0	−30	55	0
IV Upper middle income	7.9	23.6	0	−20	25	0
V Oil exporters	8.7	24.8	0	−33	59	9
VI Highly indebted countries	8.0	20.8	0	−31	30	0

Note: All data, except those on effective rates of protection, are taken from *WDR* 1987.
[a] Country Groups are defined on page xi of *WDR* 1987 (see footnotes 4–8).

with respect to the wage in that sector relative to the economywide average, is two, with the elasticity of supply of labor to services determined as a residual.

All world prices are assumed to be exogenous. Thus any change in the terms of trade is assumed to be brought about by changes in foreign agricultural protection levels. Imports are assumed to be financed by exports plus an exogenously determined level of foreign aid net of debt servicing. Thus the trade deficit equals foreign aid net of debt-servicing requirements.

Flexible wages and prices maintain full employment. All disposable income is spent, so that the trade deficit is equal to the government deficit. We assume that the proportions in which various goods and services are consumed domestically are invariant to the income distribution. Also, we assume that the government's consumption function is identical to that of the private sector and that it responds to the same tax inclusive prices that the private sector does. Thus we assume that the government adjusts taxes in order to enable it to finance its initial real consumption level with available tax revenues plus foreign aid net of debt-servicing requirements.

We postulated that the only taxes are those on agricultural exports, agricultural production for domestic consumption, imports and exports of the final industrial good, and consumption of the composite good. Services are assumed to be tax free. We also recognized that the imported final industrial good is subject to quota protection, where we assume that the ad valorem

		Distribution of gross domestic product (%)		
GNP per capita (dollars)	GDP (billions of dollars)	Agriculture AV	Industry IDV[b]	Services S
200	146	36	19	45
270	176	31	27	42
820	510	22	32	46
1,850	930	10	35	55
1,060	533	17	36	47
1,410	779	15	33	52

[b] Industry includes 'Fuels, Minerals, and Metals'.

equivalent of the quota protection is constant. We calibrated these taxes as follows.

We determined the four effective rates of protection (ERPs) indicated in table 2.1 by drawing on information contained in the 1986 and 1987 WDRs and asking experts from the World Bank and elsewhere for their best informed guesses. Our figures for ERPs reflect the facts that emerge from the 1986 and 1987 WDRs: the poorer the country is, the lower its ERP for agricultural exports (ERPAX) and the higher its ERP on import competing industry (ERPID) tend to be. We then determined the ad valorem tax on agricultural exports, at that rate which would set ERPAX at its exogenously determined level given in table 2.1. We then set the ad valorem equivalent of tariff plus quota protection on the imported final industrial good (J) at that rate which would set ERPID at its exogenously determined level. We assumed the subsidy rate on industrial exports and the tax on the production of agricultural goods for domestic consumption, which set the corresponding ERPs, ERPIX, and ERPAD equal to their predetermined levels. Data on tax revenues arising out of international trade are presented in the WDR. We then divided up the protection on J into a tariff and a quota component so that trade tax revenues in the benchmark equilibrium equaled this figure. We postulated that all mining and petroleum exports were taxed via 20 percent of royalties paid to the fixed factor, and that no additional taxes were levied on this sector. The remaining tax revenues indicated in the WDR were

Table 2.1 continued

			% Share of merchandise exports		
	Exports as % of GNP X	Resource balance (trade surplus) as % of GNP AID	Agriculture AXS	Fuels, minerals & metals DXS	Industry IXS
I Low income (other than China and India)	14	−9	53	23	24
II India	6	−3	26	25	49
III Lower middle income	23	−1	29	51	20
IV Upper middle income	28	4	16	37	47
V Oil exporters	21	3	7	84	9
VI Highly indebted countries	17	5	26	46	28

assumed to be collected via a uniform excise tax on the composite consumption good.

We wished to model the excise tax so that the marginal welfare cost of tax collection (MWC) from adjusting this tax was consistent with evidence from other sources. To accomplish this we assumed that there are efficiency costs associated with collecting this tax which are greater than would appear from just looking at the tax wedge. In reality these consist of administrative costs of tax collection; resources used up in tax avoidance, tax compliance, and tax evasion; and resource misallocation costs. To keep the modeling simple, we have modeled these as leakages in the tax collection process. We assumed that the excise taxes paid exceed the tax revenue accruing to the government by a factor consisting of bribes to the tax collector and issuers of licences.[2] The magnitude of this leakage is determined so as to set the MWC equal to our best guess of what it is in LDCs. Picking an appropriate level for the MWC is tricky because all governments are currently imposing some taxes with very high MWCs, such as tariffs, licensing fees, and the inflation tax. Moreover, they have the capacity to collect taxes with negative MWCs, such as those on pollution or by charging for import licenses and thereby diminishing socially counterproductive, rent-seeking behavior. We noted the Ballard et al. (1982) estimate of 79 percent for the MWC for the United

% Share of merchandise imports							
Food CMS	Fuels, other primary commodities, machinery, and transport equip. ZMS	Other manufactures JMS	Labor's share in manufacturing value-added $(1-\theta\kappa)$	External public debt (% of GNP)	Public debt service As % of GNP	Public debt service As % of exports	Net exports of agricultural goods (% of GNP)
17	53	30	.32	46.5	2.9	18.4	3.5
13	53	34	.49	13.5	1.0	9.3	.4
13	53	34	.30	41.4	5.7	22.9	3.5
10	57	33	.32	36.3	5.7	21.0	2.1
16	49	35	.32	34.5	5.9	25.6	−1.4
12	57	31	.31	39.1	5.1	27.8	2.0

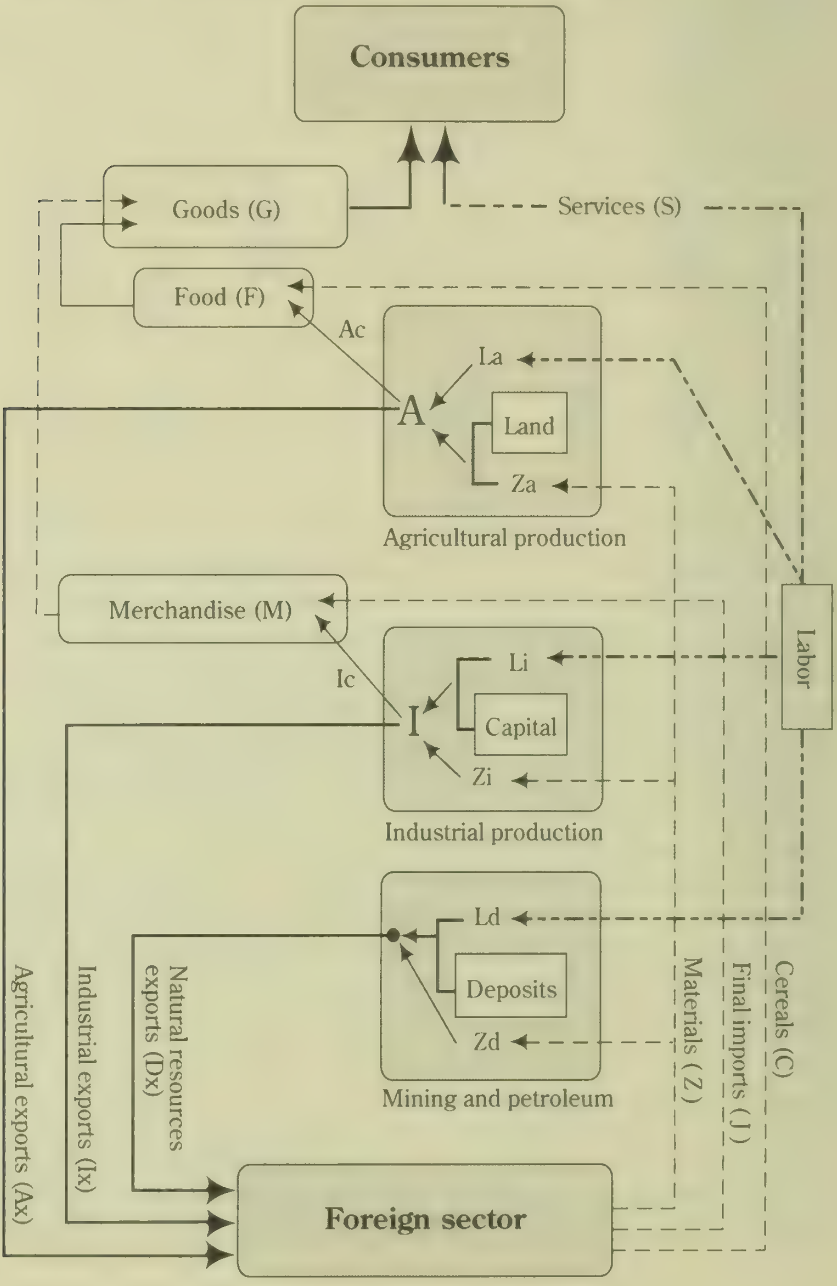
States (quoted in Shoven and Whalley 1984) and the corresponding figure of 24 percent of Charles Stuart (1984). We also asked two leading practitioners of tax reform in LDCs, who estimated 30 percent and 50 percent for the MWC via the kinds of tax increases that are likely to occur in LDCs; also, see Judd (1987). Drawing on this information, we based all of our calculations on an MWC of 40 percent, except in table 2.4, where we addressed the importance of the assumption about the MWC for our principal calculations.

We calibrated all flows to correspond to those indicated in table 2.1. We treated the imports of fuels and other primary goods and machinery and transport equipment as intermediate inputs into the three sectors, and apportioned them in proportion to value added in those sectors. All production was assumed to exhibit constant returns to scale and variable proportions. The elasticities of substitution assumed are indicated in appendix B. We assumed elasticities of substitution in production and consumption of one.

The Simulations and Results

Three simulations of the model were performed. In each case we assumed that the excise tax on domestic consumption of goods is adjusted to keep government revenues at their exogenously determined levels. In the first

Figure 2.1 A Schematic Model of a Representative LDC



simulation, we increased the exogenously determined level of government real revenues under the assumption that all revenue is returned to the private sector as a lump sum subsidy. This was done in order to assess the marginal welfare cost of tax collection in the model. In the second simulation, we assumed that foreign aid is exogenously increased, and in the third simulation, all world agricultural prices are exogenously increased. In each simulation the excise tax was adjusted to maintain real government revenue collection at its exogenously determined level.

Our discussion of how each of our economies responded to the disturbances considered follows. The model is described analytically in appendix B. Tables 2.2 to 2.7 present various cost-benefit indicators and policy implications which we have constructed from the multipliers.

Increased Real Revenues

First, consider the case of an exogenous increase in the need for real government revenues. For each of our economies, the increase in real revenues was accomplished by a tax increase that increased the consumer price index (CPI). The higher price of goods caused consumers to switch from goods to services. This reduced the consumption and output of each of the goods and raised the quantity of services provided. The reduced efficiency of the economy shrank aggregate real income as well as the real rental and wage rates for each of the groups (except tax collectors) in the economy.

Increased Foreign Aid

Next, consider the effects of an increase in the provision of foreign aid, which permits the economy to run a correspondingly larger trade deficit. Since the foreign aid is assumed to take the form of foreign currency, which is delivered to the government, when the government sells the foreign currency to the private sector it generates tax revenues which enable it, in each case, to reduce its excise tax. Consequently, the CPI fell in each case. The reduced taxation of goods caused consumers to switch at the margin from consuming services to consuming goods, so that service consumption fell, while goods consumption, output of each sector, and the labor employed in it rose at the expense of labor employed in the service sector. Imports of all goods rose, while exports of industrial and agricultural goods fell, with ex-

Table 2.2 General Equilibrium Price Elasticities for Agriculture

Group	I	II	III	IV	V	VI	All LDCs[a]
1. Agricultural production	0.7	0.4	0.7	0.9	0.6	0.6	0.7
2. Agricultural consumption	0.0	−0.3	−0.3	−0.6	−0.4	−0.4	−0.2
3. Agricultural exports	6.2	15.6	5.3	4.5	18.5	4.9	10.3

Note: Calculated as the percent response per 1 percent increase in the world price of all agricultural goods, Pa, holding foreign aid, debt repayment, and the trade balance constant. Since the relative prices of all agricultural goods are held constant and the agricultural consumption function is homothetic, agricultural imports rise by the same proportion as does agricultural consumption.

[a] All LDCs consist of the aggregate of Groups I–IV. The economies in groups V and VI are included in Groups I–IV.

ports of mining and petroleum rising. Also, aggregate real income rose, along with all real wages and rentals.

Increased World Agricultural Prices

An increase in world agricultural prices in each case increased revenues associated with import and export taxes, which made it possible to reduce the excise tax rate. In each case there was an increase in real income, the average real wage, and the agricultural real wage. Not surprisingly, agricultural production and agricultural exports both rose along with agricultural employment, while outputs of and employment in industry and mining and petroleum declined.

Cost-Benefit Analysis

Our results depend on the extent to which LDC agriculture responds to prices. Therefore, table 2.2 presents the general equilibrium elasticities of responses of agricultural production, consumption, and exports to changes in world agricultural prices. The elasticity of agricultural production varies from 0.4 to 0.9, while the income and substitution effects, with their contradictory pulls, cause the consumption elasticity to lie between 0.0 and −0.6. The assumption that agricultural goods produced for the domestic market can be transformed at constant rates into those for the foreign market implies high elasticities of agricultural exports: between 4.5 and 18.5.

Table 2.3 presents four sets of cost-benefit ratios. Row 1 is the change in LDC real income per unit increase in foreign aid or decrease in debt repay-

Table 2.3 Trade versus Aid

Group	I	II	III	IV	V	VI	All LDCs
1.[a] dY/dAID	1.23	1.94	1.75	2.05	1.85	1.81	1.74
2.[b] dY/dTR	7.87	26.70	6.74	4.55	−12.31	5.95	6.23
3.[c] d[−AID]/dTR	6.38	13.77	3.85	2.21	—	3.29	3.58
4.[d] dYROW/dTR	7.93	18.23	4.40	2.10	—	3.61	4.02

[a] Row 1 is the change in LDC real income, dY, per unit increase in foreign aid or decrease in debt repayment, dAID. The all LDC figure assumes that the incremental AID is granted so as to raise the real incomes of all LDCs in the same proportion that an increase in agricultural prices does.

[b] Row 2 is dY per unit transfer to the LDCs via an increase in world agricultural prices, dTR. Note that dTR is negative in the case of group V.

[c] Row 3 is Row 2/Row 1. It is the decrease in AID made possible by a unit increase in TR (holding LDC real income constant).

[d] Row 4 is the real income gain to the rest of the world, ROW (i.e. the LDCs' trading partners) made possible by a unit increase in TR (holding LDC real income constant), assuming no initial domestic distortions in ROW agriculture and a 40 percent marginal welfare cost of raising AID revenue in the ROW. Row 4 = 1.40 [row 3] − 1. Row 4's figures would be precisely correct if developed economies protected their agriculture with given away import licenses which caused the initial volume of trade to differ infinitesimally from free trade levels. To the extent that agricultural subsidies involve a budgetary cost and initial import restrictions cause a noninfinitesimal distortion of trade from free trade levels, the figures in Row 4 are biased downward.

ment. We see that a dollar's worth of foreign aid is worth roughly one to two dollars to the recipient country, where the change in real income is the change in consumption at consumer prices. In a nondistorted economy this figure would be one. However, the taxes which raise consumer prices above world levels, and the excise tax cut in response to the increased government revenues provided by foreign aid, cause this figure to be above unity in each case.

Row 2 is the increase in real income per unit transfer to the LDC, which is brought about by higher agricultural prices, where the transfer is defined as the terms of trade effect, consisting of the LDC's initial level of net agricultural exports multiplied by the percentage increase in agricultural prices. If the LDC were undistorted, this figure would also be unity.

However, because of the discrepancy in ERPs and the distorting taxes that can be reduced as a result of the increased collection of trade taxes brought about by the increased volume of trade, this figure greatly exceeds unity for all countries except the oil exporters (lying between 4.55 and 26.70 for the former). This is to say, for these economies the higher agricultural prices interact favorably with existing distortions to generate a marked gain in real income. If the LDCs' trading partners were undistorted, these figures would imply that each one dollar's loss of standard of living, which they sacrifice through worsened agricultural terms of trade, could increase LDCs' living standards by between \$4.55 and \$26.70. The one outlier is the group of oil-exporting countries, which exhibits a negative figure. These countries are net importers of agricultural goods. Had they been undistorted, we would have expected agricultural price hikes to shrink their real incomes; but we find that the movement of their resources into agriculture, and the reduction of their excise tax, which the increased agricultural prices brings about, is enough to increase their real incomes by \$12.31 for every dollar that is implicitly transferred to their trading partners through higher agricultural prices. Yes, there is a free lunch! But then free lunches abound in distorted economies, for that is what Pareto improvements are all about.

Row 3 shows the reduction in foreign aid or increased debt repayment which would be possible per unit increase in the transfer via increased agricultural prices to the relevant country group while leaving LDC real income unchanged. It leads to the conclusion that one dollar's worth of transfer via trade liberalization by the LDCs' trading partners is worth between \$2.21 and \$13.77 of explicit foreign aid. Thus, reducing protection of agricultural goods exported by LDCs is an effective way of subsidizing LDCs relative to foreign aid.

Row 4 shows the increase in the real income of the rest of the world (ROW) that would be made possible per dollar transferred to the relevant LDC group via higher agricultural prices, if aid or debt repayment were adjusted to leave real income in the relevant LDC group unchanged, all assuming that the marginal welfare cost of tax collection to pay foreign aid or to bail out the banking system is 40 percent. Each dollar transferred via higher agricultural prices increases ROW real income by between \$2.10 and \$18.23.

We now turn to table 2.4. For each country group the top two rows show how the first three multipliers calculated in table 2.3 depend on the elasticity of supply of labor to agriculture, industry, and mining and petroleum (holding the rate of leakage to tax collectors at the level assumed in our basic calculation). We take this elasticity, which measures labor mobility, as a proxy for the time elapsed since the disturbance. The next two rows for each country group show how these same multipliers depend on MWC, the marginal welfare cost of tax collection, which we allow to vary from a high of 140 percent to a low of between 4.6 percent to 14.1 percent, where the low figures are those which applied when a zero leakage to the tax collectors was assumed. We find that for every country group and for every set of parameter values, agricultural price hikes are at least 1.97 times as effective a way to transfer

Table 2.4 Trade versus Aid in the Long and Short Runs with Varying Efficiency of Tax Collection

Group	ε[a]	MWC(%)[b]	dY/dAID	dY/dTR	dAID/dTR
I	0	0.511	0.98	6.37	6.47
	4	49.7	1.29	8.24	6.37
	2	140	2.00	12.3	6.15
	2	8.59	0.94	6.18	6.58
II	0	0.589	1.59	16.5	10.4
	4	49.1	2.02	29.8	14.8
	2	140	3.39	44.5	13.1
	2	4.57	1.25	17.5	14.0
III	0	0.660	1.48	5.96	4.04
	4	49.4	1.81	6.95	3.85
	2	140	3.00	10.7	3.57
	2	9.95	1.21	4.95	4.11
IV	0	0.824	1.78	4.99	2.80
	4	45.8	2.10	4.50	2.15
	2	140	4.08	8.05	1.97
	2	14.1	1.51	3.62	2.40
V	0	0.606	1.58	−8.60	−5.43
	4	48.8	1.91	−13.4	−7.04
	2	140	3.33	−21.9	−6.57
	2	12.8	1.33	−9.03	−6.77
VI	0	0.697	1.55	4.44	2.86
	4	49.8	1.86	6.43	3.45
	2	140	3.24	10.0	3.09
	2	13.3	1.30	4.45	3.41

[a] The elasticity of labor supply to agriculture, industry, and mining and petroleum, as a function of the wage in that sector relative to the average wage in the economy.

[b] MWC is the assumed marginal welfare cost of taxation. The last row for each country group is the simulation, which assumes a tax leakage (*l*) of zero.

real resources to LDCs as is explicit foreign aid. This ratio is quite insensitive to the assumed MWC, which reflects the fact that both perturbations of the system contribute to government revenue. For each group we find that in the long run the efficacy of explicit aid is larger than in the short run. This reflects the greater ability of the economy to respond to changed incentives in the long run. For each group the same is true of transfers via agricultural price hikes, except for Group IV.[3] The major conclusion which we draw from the table is that our finding that trade is considerably more effective than aid is quite robust.

The first row of table 2.5 indicates the implicit transfer to LDCs due to

Table 2.5 Effects per Unit of Increased Net Agricultural Exports from LDCs

Effects	Country group						
	I	II	III	IV	V	VI	All LDCs
1. dTR/dNAE[a]	.076	.016	.099	.095	−.050	.133	.086
2. dY/dNAE[b]	.599	.423	.665	.434	.613	.794	.538
3. d[−AID]/dNAE	.486	.218	.380	.211	.332	.439	.310
4. dYROW/dNAE	.604	.289	.433	.200	.514	.482	.347
5. dNNAM/dNAE[c]	1.076	1.016	1.099	1.095	.950	1.133	1.086

[a] Row 1 is the change in TR per unit increase in NAE due to an increase in world agricultural prices, where dNAE is the change in the LDCs' net agricultural exports (valued at initial prices).
[b] Rows 2–4 of this table are calculated as the corresponding row in table 2.3 multiplied by Row 1 of this table. Thus, these rows measure effects per unit increase in NAE.
[c] Row 5 is the increase in LDCs' net nonagricultural imports, NNAM, per unit increase in NAE, assuming no change in aid or debt repayment. It is calculated as 1 + Row 1.

higher agricultural prices per increase in the LDCs' net agricultural exports. While not interesting in itself, it is used in rows 2–4 to calculate the changes in LDC real income, AID saved, and ROW real income per unit of increased net agricultural exports absorbed by the ROW. These benefit-cost ratios are relevant to the extent that policymakers or their constituencies subscribe to the mercantilistic view that increased imports are a cost, or to the extent that increased net agricultural imports are perceived to disrupt markets. Row 5 is the increased nonagricultural net exports from the rest of the world that are made possible by its increased net agricultural imports, assuming that LDCs hold their trade balances constant. Note that the figures in this row all exceed unity for the net importers of agricultural goods, since in this calculation agricultural trade is valued at initial prices and the trade balance is kept constant.

Row 2 states that each dollar's worth of net agricultural exports from LDCs (NAE) that enters developed economies increases LDC real income by $0.42 to $0.79, if aid and debt repayment levels are unchanged. From row 3, each dollar's worth of NAE could be accompanied by between $0.21 and $0.49 of reduced aid or increased debt repayment without reducing LDC real income, and (from row 4) if this is done it should increase the rest of the world's real income by between $0.20 and $0.60, assuming a marginal cost of raising aid revenue or funds to bail out the banking system equal to 40 percent. Finally, each additional dollar's worth of NAE (at initial prices) makes possible between $0.95 and $1.13 worth of increased net industrial exports to the LDCs, assuming no change in LDC debt repayment or foreign aid.

Table 2.6 Income Distribution: Trade versus Aid

	Country group						
Increase in real Y for	I	II	III	IV	V	VI	All LDCs
A. All labor	4.7	11.7	2.5	0.7	−5.7	2.8	2.2
B. Agricultural labor	5.0	22.7	3.0	0.8	−9.7	4.9	3.8
C. Agricultural sector	10.0	38.6	9.4	14.3	−22.0	9.9	11.8

Note: The increase in real incomes of labor, the initial agricultural labor force, and those factors initially employed in the agricultural sector are generated by an implicit transfer due to higher agricultural prices relative to that due to an explicit AID transfer of the same size.

Since agricultural workers tend to be the poorest in LDCs, equity is served by redistributing income to agricultural workers. Table 2.6 establishes that for each country group, transfers via the implicit transfer due to an agricultural price hike raise labor's real wage, agricultural labor's real wage, and the real income of those factors initially employed in agriculture by more than an equivalent transfer through AID.[4] Row 3 of table 2.3 can be interpreted as the increase in the real income of the economy as a whole generated by an implicit transfer due to higher agricultural prices, relative to that due to an explicit AID transfer of the same size. Only the figures for the agricultural sector as a whole exceed the corresponding figures in row 3 of table 2.3 for all groups. Thus, in countries where the agricultural workers themselves have claims to the fruit of the land, the income distributional effects of agricultural price hikes are particularly salutary relative to those of AID transfers; but even when that is not the case, the implicit transfer through agricultural price hikes still has an absolute advantage in increasing labor's real wage and agricultural labor's real wage relative to an AID transfer of the same size.

Table 2.7 analyzes the effects of a 10 percent increase in world agricultural prices, which is a reasonable guess for the change that would be observed as a consequence of liberalized agricultural markets in the developed countries. We find that for all LDCs, real income rises by $25.9 billion. This could result in an increased flow of resources to the developed world of $14.8 billion when the LDC real income is held at its initial level, or an increase in developed country real income of $16.6 billion.[5] Finally, such an improvement in the agricultural terms of trade would be enough to pay off 4.8 percent of the public debt of poorest (Group I) LDCs each year.[6]

Table 2.7 The Effects of a 10 Percent Increase in World Agricultural Prices

	Country group						
	I	II	III	IV	V	VI	All LDCs
1. Percentage increase in Y[a]	2.10	0.77	1.70	0.71	1.27	1.37	1.11
2. Δ Y ($billions)[b]	3.52	2.03	11.7	8.68	8.90	13.4	25.95
3. Δ [-AID] ($b)	2.86	1.05	6.69	4.22	4.82	7.41	14.82
4. Δ YROW ($b)	3.55	1.39	7.64	4.00	7.47	8.12	16.58
5. Δ [-AID]/Debt (%)[c]	4.82	3.94	3.31	1.27	2.72	2.43	2.38

[a] Row 1 is the percent increase in LDC real income.

[b] Rows 2–4 correspond to the same entries in Tables 2.3 and 2.4.

[c] Row 5 is the percent of external public debt which could be repaid each year by the increase in agricultural prices, holding LDC real income constant.

Conclusions

Our calculations indicate that agricultural liberalization on the part of the developed world is, compared to foreign aid, an effective way to transfer resources to the less developed world. Moreover, the income distributional effects are more salutary. Alternatively, better agricultural export prices for the less developed world can substantially enhance those countries' ability to repay debt without lowering their standard of living. Finally, it is important to note that, particularly for less developed countries, spending on imports is constrained by export earnings; so to the extent that developed countries accept more LDC exports, LDCs will increase their net imports of other goods. Thus developed country policies which restrict LDC agricultural exports in effect also restrict developed country exports of industrial goods —a result that no one should find surprising.

Appendix A. The Geometry of a Simple Version of the Model and the Welfare Impact of Resource Shifts in the Presence of Differential Effective Rates of Protection

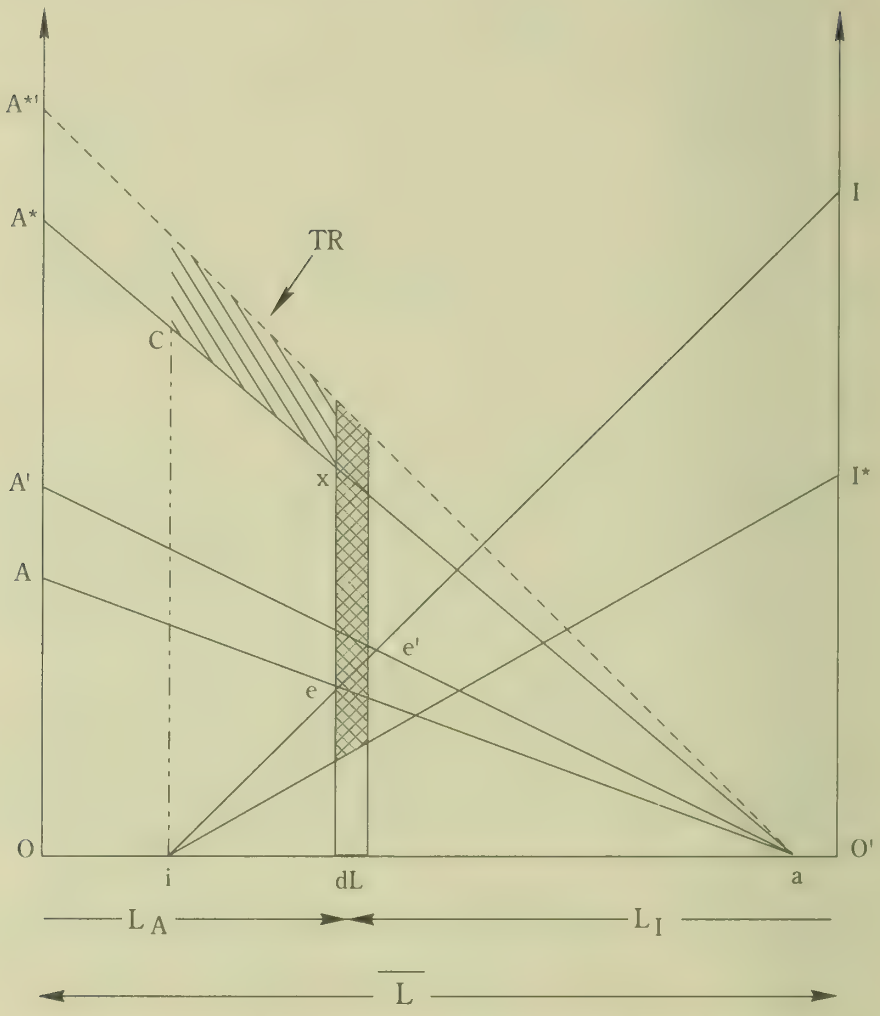
The Geometry

The basic idea behind the analysis presented in this chapter, namely that foreign exchange will be saved or earned when resources move from protected industry into negatively protected agriculture, is easily demonstrated within the context of a simple specific factors model, which is presented in figure 2.2. The economy's labor stock is measured as OO′ on the horizontal axis, with employment in agriculture measured from the left hand axis and employment in industry measured from the right hand axis. The value of the marginal product of labor (VMPL) in agriculture at initial world prices is A*a. Since there is an export tax on agriculture, the domestic agricultural price is less than the world price. Consequently, the VMPL in agriculture at domestic prices lies below the corresponding curve at world prices and is given by Aa. The VMPL in industry at world prices is given by I*i. Since the industrial good is subject to an import tariff, the domestic price exceeds the world price. Thus the VMPL in industry at domestic prices exceeds that at world prices and is given by I*i. The equilibrium wage is given by the common VMPL where the two VMPLs at domestic prices intersect at e. Thus, initially, L_A units of labor are employed in agriculture while L_I units are employed in industry. An increase in world agricultural prices raises the agricultural VMPL at world prices to A*′a, which raises the agricultural VMPL at domestic prices to A′a, and moves the new equilibrium to e′. Consequently, an amount of labor, dL, shifts from industry to agriculture. If we suppose that consumption of the agricultural good is fixed at C, and that consumption of the industrial good is fixed as well, the country will earn increased foreign exchange equal to the slashed area, which is the transfer due to the terms of trade effect plus the shaded area, which is the increased foreign exchange earnings due to the shifting of labor from positively protected industry into negatively protected agriculture. The ratio of the foreign exchange, which can be released as reduced foreign aid or increased debt repayment, to the agricultural transfer is the sum of the two areas divided by the slashed area. Obviously, if C is close to X, this ratio will be very large, and if C lies to the right of X, the ratio may even be negative, which demonstrates the point mentioned in the text—that a negative terms of trade change may be accompanied by a release of foreign exchange by the LDC and still leave LDC real income unchanged.

Resource Shifts and Differential ERPs

When intermediate inputs are used along with primary factors to produce outputs, the essential logic is the same as above, but the concept of the ERP is useful to see what drives the results. Now we explain using the ERP. The ERP coefficient for a sector, which is defined as 1 + ERP, measures the payments to primary factors (land, labor, and capital) in that sector at domes-

Figure 2.2 The Geometry of a Simple Version of the Model



tic prices, divided by the net output produced by the sector measured at world prices, i.e., divided by the foreign exchange saved or earned. Thus, its reciprocal measures the foreign exchange saved or earned per dollar paid to primary factors in the sector. If primary factors are combined with constant returns to scale to produce a value-added composite good, which is combined with intermediate inputs in fixed proportions and constant returns to scale to produce an output where both the intermediate input and the output are traded at fixed world prices, the reciprocal of the ERP coefficient measures the foreign exchange earned or saved by a dollar's worth of any primary factor. Competition assures that each factor will be paid the same in each sector. Thus, when agricultural prices rise, so that a dollar's worth of labor shifts from industry to agriculture, the resource shift from sector I to A will result in increased net foreign exchange earnings equal to

$$1/[1+ERP_A]-1/[1+ERP_I]$$
$$=[ERP_I-ERP_A] / \{[1+ERP_A][1+ERP_I]\}.$$

Thus, any policies which drive primary factors from sector I to A will be beneficial if A has the lower ERP. For example, using the figures for our low income countries, each dollar's worth of labor, which is driven by higher agricultural prices from import-competing industry (with its ERP of 100 percent) into export agriculture (with its ERP of −40 percent) (with imported final industrial goods replacing the reduced industrial production), will raise net foreign exchange earnings by $1.17. Moreover, this extra foreign exchange will accrue to the government through its structure of trade taxes. Consequently, a better agricultural price bestows a welfare gain on the country even before labor moves—because of the increase in foreign exchange earned and trade taxes collected on the increased value of initial exports—and this welfare gain is further augmented by the increased foreign exchange earning and tax collection due to the labor mobility. Since we assume that intermediate inputs are combined with the value-added composite in variable proportions to produce outputs, this story is a simplified version of the one we have told, but it highlights the mechanisms at work. It also shows how to use ERPs for measuring the benefits associated with altered economic efficiency and tax collection arising out of resource shifts.

Appendix B. The Model Described Analytically

In this appendix we present the equations which make up the model. The reader should review the section titled "Modeling a Representative Less Developed Country" and read this appendix in conjunction with figure 2.1. The mathematics of all the equations which make up the model are explained in the chapter supplements of Caves and Jones (1985) and Tower (1984, chapter 2). We start at the top of figure 2.1 and work downward. Throughout this study we use hats "ˆ" to denote proportional changes.

There are two consumers with identical and homothetic tastes in the model: the private sector, under which we lump both consumption and gross investment, and the government, which is assumed to face the same prices as the private sector.

The proportional change in the price level to these final demanders, $\widehat{CPI}$, is given by the sum of the share weighted proportional changes in the prices of the two items consumed, services and goods:

$$[\widehat{CPI}] = \phi_s \hat{W}_s + [1 - \phi_s]\hat{P}_{gb} \tag{1}$$

where ϕ_s is the share of income spent on services, which are assumed to be produced using labor alone, so that W_s is both the wage in services and the price of a service, and P_{gb} is the price of the other item, "goods," to buyers. Goods are themselves a composite of various other items, as we shall see. Services correspond to "services" in the national income accounts presented in the *World Development Report 1987.* They are assumed to be untaxed and are produced using labor alone.

Defining a unit of real income as the extra utility generated by the expenditure of a unit of domestic currency at constant prices of goods and services, and assuming competition and utility maximization so that the marginal utility of money spent is the same in all uses, yields

$$\hat{Y} = \phi_s \hat{S} + [1 - \phi_s]\hat{G} \tag{2}$$

where Y is the economy's real income and S and G are its final demands for services and goods. In what follows we will hold the government's "real income" constant although we will permit the bundle of goods and services it consumes to alter in accordance with changed relative prices. Thus $\hat{Y}$ represents the change in the private sector's real income as a proportion of the economy's real income.

The bundle of goods and services in final demand is assumed to depend on relative prices in accordance with

$$\hat{G} - \hat{S} = \sigma_s[\hat{W} - \hat{P}_{gb}] \tag{3}$$

where σ_s is the elasticity of substitution in consumption between the two items, and as we know from the hat calculus, $\hat{G} - \hat{S} = \widehat{G/S}$.

We denote the equations which we used in solving the model with numbers alone, and the equations which are used to derive them we denote with numbers followed by letters. The price of goods to sellers is denoted by P_g.

The excise tax on consumption of goods is denoted by $[1 + l]t$, where a fraction $l > 0$ of these tax revenues are assumed to leak out as bribes to the tax collectors or as bribes for licenses, so that only the fraction t of the value of the sales prices of goods consists of government revenues.

$$P_{gb} = (1 + [1 + l]t)P_g. \tag{4a}$$

Consequently,

$$\hat{P}_{gb} = l dt/(1 + [1 + l]t) + \hat{P}_g. \tag{4}$$

Goods are assumed to consist of a composite generated from two items: merchandise and food. We denote quantities and prices of these items as M, F, P_m, and P_f, with the elasticity of substitution between them as σ_f. Throughout this study, production is assumed to be characterized by constant returns to scale and variable proportions. This gives us three more equations, which are analogous to (1), (2), and (3):

$$\hat{P}_g = \theta_m \hat{P}_m + [1 - \theta_m]\hat{P}_f, \tag{5}$$

$$\hat{G} = \theta_m \hat{M} + [1 - \theta_m]\hat{F}, \tag{6}$$

and

$$\hat{M} - \hat{F} = \sigma_f [\hat{P}_f - \hat{P}_m] \tag{7}$$

where θ_m is the share of output of G, which is spent on inputs of M.

Food is a composite of imported agricultural items, which we refer to as cereal and denote by C, and domestically produced agriculture. Cereals are not taxed in the home economy, so P_c denotes their price both on world markets and to buyers. An amount, A_c, of the home-produced agricultural good is used in food production to be consumed at home and an amount, A_x, of it is exported. Its price to home buyers for use in food is denoted by P_{ab}. Defining θ_a as the share of home agriculture in food production and σ_{ac} as the elasticity of substitution between agriculture and cereals, gives us

$$\hat{P}_f = \theta_a \hat{P}_{ab} + [1 - \theta_a]\hat{P}_c, \tag{8}$$

$$\hat{F} = \theta_a \hat{A}_c + [1 - \theta_a]\hat{C}, \tag{9}$$

and

$$\hat{A}_c - \hat{C} = \sigma_{ac}[\hat{P}_c - \hat{P}_{ab}]. \tag{10}$$

Production of the agricultural good, A, with price P_a uses agricultural labor, L_a, with wage, W_a, and a composite, T_z, with price P_{tz}. P_{ab} exceeds P_a by a constant ad valorem tax rate. Defining the elasticity of substitution between these two inputs as σ_a, and labor's share in A as θ_L, yields

$$\hat{P}_a = \theta_L \hat{W}_a + (1 - \theta_L)\hat{P}_{tz}, \tag{11}$$

$$\hat{A} = \theta_L \hat{L}_a + [1 - \theta_L]\hat{T}_z, \tag{12}$$

and

$$\hat{L}_a - \hat{T}_z = \sigma_a(\hat{P}_{tz} - \hat{W}_a). \tag{13}$$

The agricultural composite is produced with a fixed amount of land, T, whose rental is denoted by N, and the imported material input, Z_a, whose price is frozen by its fixed world price. Denoting the share of Z_a in the agricultural composite by θ_{za}, and the elasticity of substitution between the two inputs as σ_{za}, yields

$$\hat{P}_{tz} = [1 - \theta_{za}]\hat{N}, \tag{14}$$

$$\hat{T}_z = \theta_{za}\hat{Z}_a, \tag{15}$$

and

$$\hat{Z}_a = \sigma_{za}\hat{N}. \tag{16}$$

Merchandise, M, is produced using a quantity, I_c, of the domestically produced industrial good, with price P_i, and a quantity, J, of the imported final good, with price to the buyer of P_j. Denoting the share of I_c in M by θ_i, and the elasticity of substitution between the two items by σ_i, gives

$$\hat{P}_m = \theta_i \hat{P}_i + [1 - \theta_i]\hat{P}_j, \tag{17}$$

$$\hat{M} = \theta_i \hat{I}_c + [1 - \theta_i]\,\hat{J}, \tag{18}$$

and

$$\hat{I}_c - \hat{J} = \sigma_i[\hat{P}_j - \hat{P}_i]. \tag{19}$$

Output of the industrial good, I, is produced using a value-added composite, V, with price P_v and imported intermediate inputs, Z_i, with a price that is fixed by world markets. The composite's share of I is θ_v and the elasticity of substitution is σ_v, so we have

$$\hat{P}_i = \theta_v \hat{P}_v, \tag{20}$$

$$\hat{I} = \theta_v \hat{V} + [1 - \theta_v]\hat{Z}_i, \tag{21}$$

and

$$\hat{Z}_i - \hat{V} = \sigma_v \hat{p}_v. \tag{22}$$

The industrial composite is produced using labor, L_i, with wage W_i and a fixed capital stock with rental rate R. Capital's share is θ_k and the elasticity of substitution between the two factors is σ_k, so

$$\hat{P}_v = \theta_k \hat{R} + [1 - \theta_k]\hat{W}_i, \tag{23}$$

$$\hat{V} = [1 - \theta_k]\hat{L}_i, \tag{24}$$

and

$$\hat{L}_i = \sigma_k[\hat{R} - \hat{W}_i]. \tag{25}$$

The imported final good is subject to both tariff and quota restrictions which result in its price to buyers, P_j, exceeding its fixed world price, which is defined equal to unity, by a proportion t_j, which we refer to as the tariff-quota wedge. Thus

$$P_j = (1 + t_j) \tag{26a}$$

so

$$\hat{P}_j = dt_j/(1 + t_j). \tag{26}$$

The mining and petroleum sector produces output, D_x, all of which is exported and sold at a fixed world price of unity. It uses a composite, D_v, with price P_{dv} , in combination with a quantity of imported intermediates given by Z_d , whose price is fixed on the world market at unity. Denoting the composite's share in D_x by θ_{zd}, and the elasticity of substitution by σ_{zd}, yields

$$0 = \hat{P}_{dv}[1 - \theta_{zd}], \tag{27}$$

$$\hat{D}_x = \theta_{zd} Z_d + [1 - \theta_{zd}]\hat{D}_v, \tag{28}$$

and

$$\hat{Z}_d - \hat{D}_v = \sigma_{zd}\hat{P}_{dv}. \tag{29}$$

The mining and petroleum composite is produced using labor, L_d, with wage W_d and a fixed factor denoted by D for deposits, with rental price R_d.

Deposit's share is θ_d and the elasticity of substitution is σ_d. Thus

$$\hat{P}_{dv} = \theta_d\hat{R}_d + [1 - \theta_d]\hat{W}_d, \tag{30}$$

$$\hat{D}_v = [1 - \theta_d]\hat{L}_d, \tag{31}$$

and

$$\hat{L}_d = \sigma_d[\hat{R}_d - \hat{W}_d]. \tag{32}$$

The balance of payments equation is given by

$$D_x + I_x + A_xP_a^* + [AID] = CP_c + J + Z_a + Z_d + Z_i, \tag{33a}$$

where all world prices except for those of the two agricultural goods and the industrial export are fixed at unity; D_x, I_x, and A_x are respectively, exports of the mining, industrial, and agricultural good; AID is the balance of trade deficit, and the right-hand side of the equation represents the value of imports. Differentiating yields

$$D_x\hat{D}_x + I_x\hat{I}_x + A_xP_a^*[\hat{A}_x + \hat{P}_a^*] + [AID]\widehat{AID} = C\hat{C} + C\hat{P}_c + J\hat{J} + Z_a\hat{Z}_a + Z_d\hat{Z}_d + Z_i\hat{Z}_i. \tag{33}$$

Material balance in industry implies

$$I_c + I_x = I, \tag{34a}$$

so

$$I_c\hat{I}_c + I_x\hat{I}_x = I\hat{I}. \tag{34}$$

Similarly, material balance in agriculture implies

$$A_c\hat{A}_c + A_x\hat{A}_x = A\hat{A}. \tag{35}$$

Government revenue, [REV], is the sum of tax revenue plus foreign aid. It is given by

$$[REV] = tP_gG + \tau\, t_j\, J + t_{ax}P_a^*A_x + t_{ac}P_aA_c - s_{ix}I_x + t_dDR_d + [AID], \tag{36a}$$

where τ is the fraction of the tariff-quota wedge, t_j, which is accounted for by the tariff on J, and τ is assumed to be constant; t_{ax} (s_{ix}) is the ad valorem export tax (subsidy) on agricultural (industrial) exports, expressed as a proportion of world price, P_a^* ($P_i^* = 1$); t_{ac} is the ad valorem tax imposed on home consumption of domestically produced agricultural goods; t_d is the share of payments to the "fixed factor" in mining and petroleum that accrues as taxes to the government; D is the stock of the "fixed factor" in mining and petroleum (the rate at which ore is mined); and R_d is the rental payments per unit of ore. Conceptually, DR_d also includes payments for reproducible capital located in mining and petroleum. Letting δ be the proportional increase in real tax revenues, which we include in order subsequently to calculate the marginal welfare cost of tax collection, we have

$$\delta = \frac{P_g G dt + t P_g G[\hat{P}_g + \hat{G}] + \tau J dt_j + t_j \tau J \hat{J} + t_{ax} P_a^* A_x [\hat{P}_a^* + \hat{A}_x]}{REV} + \frac{t_{ac} P_a A_c [\hat{P}_a + \hat{A}_c] - s_{ix} I_x \hat{I}_x + t_d R_d D \hat{R}_d + AID\widehat{AID}}{REV} - \widehat{CPI} \tag{36}$$

We assume that labor is homogenous when measured in efficiency units. We denote labor's share in the i^{th} sector in economywide labor earnings as λ_i. Thus the proportional change in the average wage paid in the economy is given by

$$\hat{W} = \lambda_s \hat{W}_s + \lambda_a \hat{W}_a + \lambda_i \hat{W}_i + \lambda_d \hat{W}_d. \tag{37}$$

Full employment dictates

$$0 + S\hat{S} + L_a \hat{L}_a + L_i \hat{L}_i + L_d \hat{L}_d. \tag{38}$$

The elasticity of supply of labor to the various sectors, with respect to the wage in each sector relative to the average, is denoted by ε_i, so

$$\hat{L}_a = \varepsilon_a (\hat{W}_a - \hat{W}), \tag{39}$$

$$\hat{L}_i = \varepsilon_i (\hat{W}_i - \hat{W}), \tag{40}$$

and

$$\hat{L}_d = \varepsilon_d (\hat{W}_d - \hat{W}), \tag{41}$$

where we have suppressed the corresponding equation for the services sector, because it is redundant.

The agricultural tax rates are frozen, so the proportional changes in all agricultural prices are identical. This means that

$$\hat{P}_{ab} = \hat{P}_a - \hat{P}_a^* = \hat{P}_c. \tag*{(42)–(44)}$$

The industrial export subsidy is fixed as is the world price of the industrial export. Consequently

$$\hat{P}_i^* = 0. \tag{45}$$

Quota rents collected on the import of J are denoted by Q, and they are assumed to constitute a fixed fraction $(1 - \tau)$ of the price differential on the trade in J. Thus

$$Q = t_j\, J(1 - \tau), \tag{46a}$$

so

$$\hat{Q} = \hat{J} + (dt_j/t_j). \tag{46}$$

Finally, denoting real factor returns with "*" gives us a set of equations for proportional changes in real wages and rentals:

$$\hat{W}^* = \hat{W} - [\widehat{CPI}] \tag{47}$$

$$\hat{W}_a^* = \hat{W}_a - [\widehat{CPI}] \tag{48}$$

$$\hat{W}_d^* = \hat{W}_d - [\widehat{CPI}] \tag{49}$$

$$\hat{W}_i^* = \hat{W}_i - [\widehat{CPI}] \tag{50}$$

$$\hat{R}^* = \hat{R} - [\widehat{CPI}] \tag{51}$$

$$\hat{R}_d^* = \hat{R}_d - [\widehat{CPI}] \tag{52}$$

$$\hat{N}^* = \hat{N} - [\widehat{CPI}] \tag{53}$$

$$\hat{Q}^* = \hat{Q} - [\widehat{CPI}] \tag{54}$$

These fifty-four equations constitute our model in three exogenous variables, $\hat{P}_a$, $\hat{\delta}$, and $\widehat{AID}$ and fifty-four endogenous variables.

Finally, we used the following sets of values for our constants:

$\sigma_f = 1$

$\sigma_a = \sigma_{ac} = \sigma_i = \sigma_k = \sigma_s = 1$

$\sigma_d = \sigma_v = \sigma_{za} = \sigma_{zd} = 1$

$\theta_t = 1/3$

$\theta_d = \theta_k$, which is defined as [1 – labor's share in industry], where labor's share is read in from the data on the various country groups' labor share in manufacturing,

$\varepsilon_a = \varepsilon_i = \varepsilon_d = 2.$

Appendix C. The Country Composition of Each Group of Economies

Group I is low-income economies other than China and India. These are economies with 1985 GNP per person of $400 or less. The group consists of Ethiopia, Bangladesh, Burkina Faso, Mali, Bhutan, Mozambique, Nepal, Malawi, Zaire, Burma, Burundi, Togo, Madagascar, Niger, Benin, Central African Republic, Rwanda, Somalia, Kenya, Tanzania, Sudan, Haiti, Guinea, Sierra Leone, Senegal, Ghana, Pakistan, Sri Lanka, and Zambia, in increasing order of per person GNP.

Group II is India.

Group III is lower middle income developing economies. These are less developed economies with per person incomes in 1985 between $401 and $1,600. This group consists of the following, in ascending order of GNP, Mauritania, Bolivia, Lesotho, Liberia, Indonesia, Yemen PDR, Yemen Arab Republic, Morocco, Philippines, Egypt, Ivory Coast, Papua New Guinea, Zimbabwe, Honduras, Nicaragua, Dominican Republic, Nigeria, Thailand, Cameroon, El Salvador, Botswana, Paraguay, Jamaica, Peru, Turkey, Mauritius, Congo, Ecuador, Tunisia, Guatemala, Costa Rica, Colombia, Chile, Jordan, and Syria.

Group IV is upper middle income developing economies. These are developing economies with per person real incomes in 1985 between $1,600 and $7,500. They are, in ascending order of GNP, Brazil, Uruguay, Hungary, Portugal, Malaysia, South Africa, Poland, Yugoslavia, Mexico, Panama, Argentina, Korea, Algeria, Venezuela, Greece, Israel, Trinidad and Tobago, Hong Kong, Oman, and Singapore.

Group V is oil-exporting developing economies. These are middle income developing economies with exports of petroleum and gas, including re-exports, accounting for 30 percent or more of merchandise exports: Algeria, Egypt, Cameroon, Ecuador, Gabon, Indonesia, Iraq, Mexico, Nigeria, Oman, Congo, Syria, Trinidad and Tobago, and Venezuela.

Group VI is highly indebted economies. These are economies which are "deemed to have encountered severe debt servicing difficulties: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ivory Coast, Ecuador, Jamaica, Mexico, Morocco, Nigeria, Peru, Philippines, Uruguay, Venezuela, and Yugoslavia."

These definitions are drawn from page xi of the 1987 WDR.

Notes

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1. See, for example, table 2.1, last column.

2. Conrad (1986, 11) writes, "A 1970 study by Jap Kim Siong (1971) estimated that in 1971 the total burden of taxes (including side payments) in Indonesia was 18 percent of GDP compared with only 9 percent of GDP reported to the Tax Department." In our model, consumption by the tax collectors out of bribes constitutes part of real income.

3. For Group IV, in the long run relative to the short run, agricultural exports increase by more; but labor moves into untaxed services out of industry and mining and petroleum, which causes goods consumption and imports of final industrial goods to rise by less. The fact that these latter two flows across tax distortions are lower in the long run, shrinks the long-run real income gain below the short-run gain.

4. The figures for Country Group V indicate that the implicit transfer away from that group due to higher agricultural prices will raise real income of the relevant factor of production by more than an explicit AID transfer of the same size to that group.

5. This is $69.36 per citizen of the United States, or .416 percent of U.S. GNP.

6. It is interesting to compare these results with two sets of results on pp. 128–130 of the 1986 WDR.

Results from a study by Valdés and Zietz (1980), presented in their table 6.6, show that a 50 percent decrease in OECD agricultural tariff rates in 1975–77 would result in efficiency gains of 922 million 1980 dollars. This is considerably less than the figure that we obtain.

Anderson and Tyers, in their background paper for the 1986 WDR, find that liberalization of markets for the main temperate zone agricultural products by the industrial countries would result in worldwide efficiency gains of 25.6 billion 1980 dollars, with a gain of $48.5 billion accruing to the industrial market economies, a loss of $11.1 billion accruing to the developing countries, and a loss of $11.8 billion accruing to the East European nonmarket economies.

References

Ballard, C., J. B. Shoven, and J. Whalley. 1982. *The welfare costs of distortions in the U.S. tax system: A general equilibrium approach.* National Bureau of Economic Research Working Paper no. 1043 (December). Cambridge, Mass.

Caves, R. E., and R. W. Jones. 1985. *World trade and payments.* 4th ed. Boston: Little, Brown, and Co.

Conrad, R. F. 1986. *Essays on the Indonesian tax reform.* Country Policy Department Discussion Paper no. 1986-8. Washington, D.C.: World Bank. Typescript.

Food and Agriculture Organization. 1985. *FAO trade yearbook 1985*, volume 39. FAO Statistics Series no. 72. Rome.

Gan, K. P., and E. Tower. 1987. A general equilibrum cost-benefit approach to policy reform and project evaluation in Malaysia. *Singapore Economic Review* 32:46–61.

Judd, K. L. 1987. The welfare cost of factor taxation in a perfect-foresight model. *Journal of Political Economy* 95:675–709.

Krueger, A. O. 1983. *Trade and employment in developing countries. Vol. 3, Synthesis and conclusions.* Chicago: Univ. of Chicago Press.

Robinson, S. 1988. Multisectoral models of developing countries: A survey. In *Handbook of development economics*, ed. H. B. Chenery and T. N. Srinivasan. Amsterdam: North-Holland Publishing Co.

Shoven, J. B., and J. Whalley. 1984. Applied general-equilibrium models of taxation and international trade: An introduction and survey. *Journal of Economic Literature* 22:1007-51.

Siong, J. K. 1971. *De Indonesische vennootschapsbelasting.* Deventer: Kluwer.

Stuart, C. 1984. Welfare costs of additional tax revenue in the United States. *American Economic Review* 74:352–62.

Tower, E., and R. E. Christiansen. 1988. A model of the effect of a fertilizer subsidy on income distribution and efficiency in Malawi. *Eastern Africa Economic Review* 4: December.

Tower, E. 1984. *Effective protection, domestic resource cost and shadow prices: A general equilibrium perspective.* World Bank Staff Working Paper no. 664 (September). Washington, D.C.

Tyers, R., and K. Anderson. 1986. *Distortions in world food markets: A quantitative assessment.* Background paper for the 1986 World Development Report. Canberra: National Centre for Development Studies, Australian National University.

Valdés, A., and J. Zietz. 1980. *Agricultural protection in OECD countries: Its cost to less developed countries.* International Food Policy Research Institute, Research Report 21. Washington, D.C.

World Bank. 1986. *World development report 1986.* New York: Oxford University Press.

World Bank. 1987. *World development report 1987.* New York: Oxford University Press.

Zietz, J., and A. Valdés. 1986. *The costs of protectionism to developing countries: An analysis for selected agricultural products.* World Bank Staff Working Paper no. 769. Washington, D.C.

3. Some Economywide Effects of Agricultural Policies in the European Community: A General Equilibrium Study

Andrew B. Stoeckel and Jens Breckling

Summary

The Common Agricultural Policy of the European Community has transformed its agricultural sector. Formerly the world's largest importer of temperate zone agricultural products, the Community has become the world's second largest exporter. This transformation has been achieved at an extremely high cost in terms of opportunities given up in other areas of the economy.

Partly as a consequence of this high cost of agricultural support, the macroeconomic performance of the Community through the 1980s has fallen behind other OECD countries such as the United States and Japan. This chapter assesses the impact of high agricultural support of the farming sector on the manufacturing and services sector of the Community. In particular, it focuses on the effect that diverting resources into agriculture may have had on one of the Community's most pressing economic problems: persistent high levels of unemployment.

To trace the impact of agricultural support on the economy of the EC, we use a general equilibrium model representing the four largest economies of the EC: the Federal Republic of Germany, France, Italy, and the United Kingdom. We find that protection of agriculture in the Community has had a major adverse impact on the rest of the economy. Manufacturing output and exports are lower than they otherwise would be and jobs in the manufacturing and services sector have been lost. If real wages are rigid to any signifi-

cant degree, as asserted by many observers, aggregate unemployment in the Community has probably been worsened by the Common Agricultural Policy. That is, jobs are being lost, not saved, as a result of the high cost of protecting European farmers.

Introduction

Reform of agricultural policies is now one of the most pressing problems in the European Community. During periods of depressed prices on world agricultural markets, the European budget typically runs into financial crisis, requiring spending to be curtailed or additional revenue to be raised. By ingenious financial innovations, some changes to agricultural programs, and a recovery in world agricultural prices in 1988, the EC has in recent years managed to avoid substantial reforms of its agricultural policies and has moved from one financial crisis to the next.

This financial problem, and how it should be tackled, consumes most of the time of EC officials and spawns much public debate. However, what is less visible and receives less debate, despite its greater significance, is the nonbudgetary costs and the economywide effects of the support given to agriculture. And it is this lack of debate on economywide effects which lies behind the main political economy problem limiting the prospects for reform of agricultural policies in the EC. The recent OECD survey by Winters (1987) of economywide effects of agricultural policies in OECD countries underscores this dearth of knowledge.

The purpose of this chapter is to highlight the intersectoral or economywide effects of the agricultural policies of the European Community. The approach taken is to use the multicountry general equilibrium model of the EC, developed by Breckling, Thorpe, and Stoeckel (1988). The findings of this study confirmed the results reported by Stoeckel (1985) and Breckling, Stoeckel, and Thorpe (1987). All of these studies identified large economywide effects of the agricultural support policies. These effects are so large that agricultural protectionism is a significant factor in the EC's relative economic malaise. The multicountry version of the general equilibrium sector analysis (Breckling et al. 1987) further revealed large differences between countries with regard to who benefits and who loses from the Common Agricultural Policy (CAP).

In this study, the results from this earlier work are updated to incorporate the improved understanding of the size of the transfers to EC agriculture from the work undertaken by OECD (1987). The main nonagricultural effects examined in this chapter are the effects on the other export- and import-competing sectors of the European Community and unemployment.

Why Reform of the CAP Is So Slow

The need for reform of the CAP has been recognized for many years. Consider the following comment, written by the European Commission at a time when the Mansholt plan was drawn up, more than a decade and a half ago.

> The Community is now saddled, for many commodities, with surpluses some of which have no prospect of outlets on saturated world markets. Where outlets do exist, surpluses depress prices so that they can only be sold at high cost to the Community's budget. . . . It is therefore vital, in future, to adopt another policy for farm prices. (Duchene, Szczepanik, and Legg 1985, 192)

As Duchene et al. conclude:

> That an early text from the heart of the Community should still be apposite today, and that during the intervening period so little attention has been paid, in itself conveys a message. Ideas in this field have no weight unless they commit the political forces in play. Social pressures of immense power have determined the progress of the CAP, as they have the national policies before and since its inception. Only political counter-forces of similar power are likely to divert them. (p. 192)

In essence, it is argued, reform of the agricultural policies will only come about when sufficient countervailing political forces exist to offset the vested interests in the agricultural sector. These offsetting forces must come from those groups bearing the burden of the CAP; and those groups principally lie outside the agricultural sector. For reform to be slow, either the costs to the groups bearing the burden are too small to worry about or these groups must be unaware of the real costs of the CAP.

The third case—that those groups bearing the burden actually want to support agriculture in the present form—cannot logically hold. The reason is that objectives stated for the CAP can be achieved by more efficient, less costly means (BAE 1985; Stoeckel 1985). (For a brief summary of the objectives and instruments of the CAP, see appendix A.) Only if a stated objective of the CAP was to become more than self-sufficient—to overproduce embarrassing surpluses which have to be disposed of on world markets at a substantial loss and to give three-quarters of the support to the top one-quarter of farmers—only then would the present reliance on price support instruments for agricultural protection be consistent with some revealed European preference for support of their agricultural sector. In short, the agricultural supports for EC farming do not achieve all of their stated objectives, and to the extent they do, more direct and efficient policy instruments—such as direct income supports—are available.

The slow reform of the CAP must then lie in the first two explanations: either the costs are not that great or those groups bearing the burden are largely unaware of the real costs of the CAP—that is, the full economic costs and not just the visible and relatively smaller (but absolutely large) budgetary costs. What then are the real economic costs of the CAP and what is already known about these costs?

The Economic Costs of EC Agricultural Policies

A basic fact of economics is that support of one sector of an economy results in large costs elsewhere. Someone has to pay, and in the case of support for a tradables sector, like agriculture, the theory is reasonably clear: the other tradables sectors largely bear the burden. This burden is in terms of lower output, lower factor returns, and lower incomes than would otherwise occur.

In the case of the European economy, it is the sectors producing exports of unprotected manufactures that largely bear the burden of agricultural protectionism. And the economic effects are not just confined to the static effects of lower output or incomes: dynamic effects such as lower investment and even the failure of new industries to emerge are apparent. As Clements and Sjaastad (1984) note,

> The protection of import-competing industries . . . has been at the expense of the export industries, particularly non-traditional exports like manufactures in developing countries. Non-traditional exports have grown slowly (or even failed to emerge) because the required resources (including entrepreneurial skills) are locked by protection into import-competing activities. The protection of jobs in import-competing industries is clearly at the expense of jobs elsewhere. If existing jobs are protected, one should not be surprised to see few new jobs being created in export-oriented industries. Although by its very nature protection is designed to help domestic

> industry and employment, the economy-wide implications of protection mean that such policies have perverse effects and, on balance, can hurt the domestic economy. That is to say, the implicit tax on exporters does so much damage to the economy in terms of economic inefficiency and unemployment that it may entirely destroy the beneficial effects enjoyed by the import-competing firms. (pp.3–4)

Other costs can also be apparent, depending on the makeup of domestic regulations in each economy. For example, if factors of production cannot move to more profitable uses, the costs of distortions will be greater. In the EC, institutionalized rigid real wages impede the movement of resources in response to protection for a given sector and increase the economic costs of the support. The evidence for this real wage rigidity is given below but the effects on unemployment and industry output depend on domestic policy settings.

The total transfers to agriculture in the EC from all sources have been estimated at between 57 and 73 billion ECU a year (in 1984 values) for the period between 1976 and 1985 (BAE 1985). That is, approximately 60 percent of the value added by the sector has been derived from transfers from elsewhere in the economy. These direct and indirect transfers, after allowing for the effect of the Community's policies on world prices, have been responsible for a large transformation of EC agriculture. Under these agricultural policies, the Community has gone from being the world's largest importer of temperate zone agricultural products to becoming the world's second largest exporter (BAE 1985).

With transfers of this size, it is understandable that there could be large effects on other sectors of the economy. The earlier study by Stoeckel (1985) estimated that manufacturing output in the EC could be 1.5 percent lower and exports 4 percent lower, as a consequence of agricultural supports. Also, with real wage rigidity, around one million jobs could have been lost. The subsequent updated and disaggregated study by Breckling et al. (1987) estimated that the manufacturing and services sectors contract by roughly 1 percent in each of the four main countries except the United Kingdom, where the contraction is much sharper at 2.5 percent for manufacturing and 3.1 percent for services. For the four countries, around 860,000 fewer persons could be employed as a consequence of the agricultural policies of the Community—a total loss (on a pro rata basis) for the EC-10 of around one million jobs. However, in the study by Breckling, Stoeckel, and Thorpe (1987), national government supports were not considered and elasticities of export demand which could be considered as a lower limit were used. Since the release of this study, considerable work has been published on the size of agricultural support in OECD countries and the impact on world prices and quantities traded (OECD 1987; USDA 1987; Anderson and Tyers 1988). These estimates rely on partial calculations, but they do model complex agricultural systems with feed grain/livestock trade-offs. These estimates of support and elasticities are used here, together with the general equilibrium model reported in Breckling, Thorpe, and Stoeckel (1988), to test for the economywide impacts of agricultural support policies. For a summary of other studies, for example, Gerken (1986), Spencer (1986), and several partial equilibrium analyses, see Winters (1987).

Economic Features of the EC

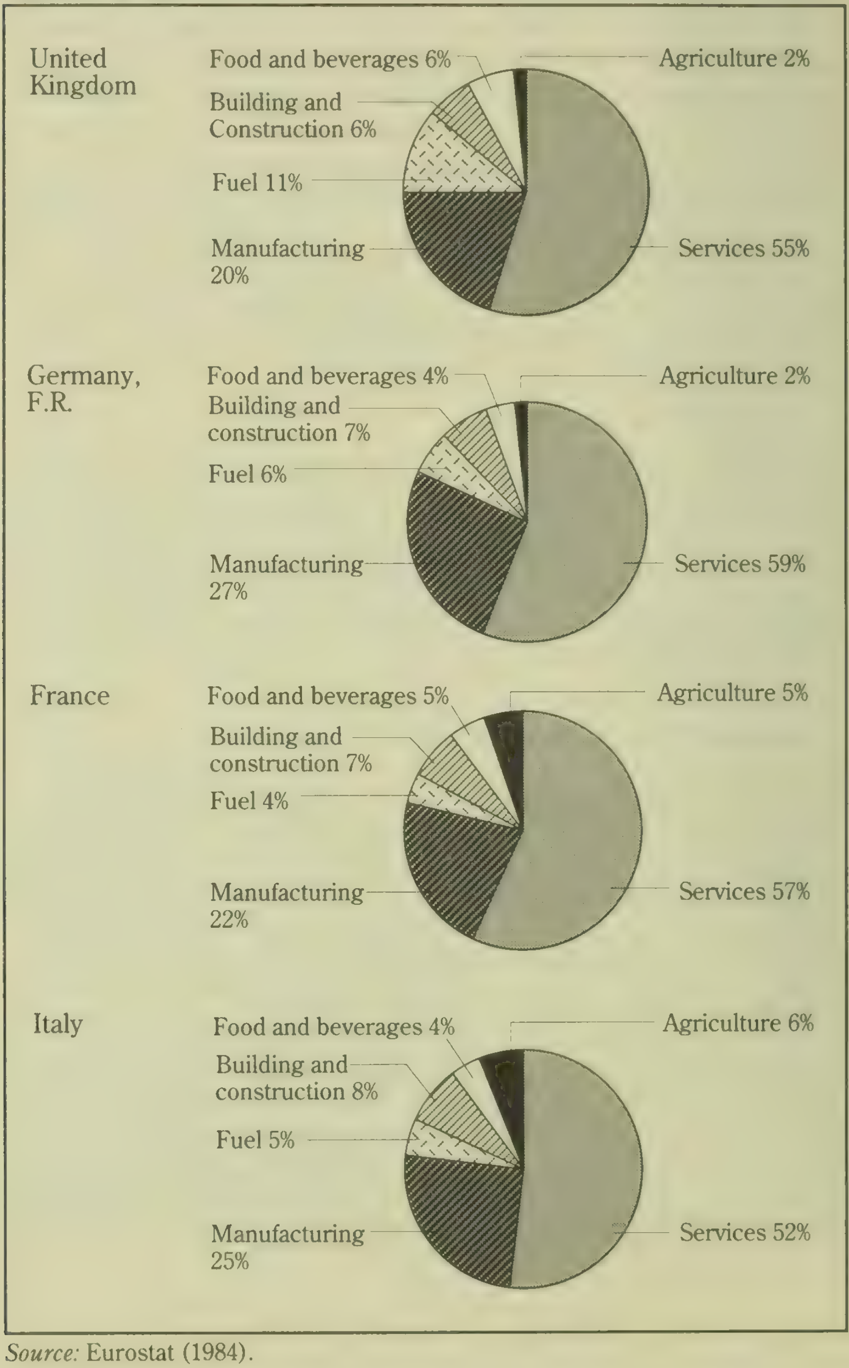
Three features of the European Community need to be incorporated into the model and are reviewed here to assist in interpretation of the results: the broad structure of the Community—the sectoral composition and relationships between the different sectors; the large number of small farms and structural adjustment in the agricultural sector; and the presence of unemployment and real wage rigidities.

Broad Sectoral Composition of the EC

The broad sectoral composition of each of the four largest economies is shown in figure 3.1. These four economies account for 86 percent of the gross domestic product in the EC-10. Of the four countries, the Federal Republic of Germany is the largest, accounting for 28 percent of the gross domestic product of the EC-10. Germany is the largest manufacturing economy, is the only country which is a net importer of EC agricultural products, and is the largest net contributor to the EC budget.

France is the second largest economy, accounting for some 23 percent of gross domestic product in the Community. Of the four main economies of the Community, France has the largest agricultural sector, and as such has been a large net recipient of support provided under the CAP. More recently, however, with the inclusion of Spain and Portugal, it has moved closer toward balance between contributions and receipts. France also has a large manufacturing sector and is comparatively export oriented.

Figure 3.1 Sectoral Gross Value Added at Market Prices for Selected EC Countries in 1982



Source: Eurostat (1984).

Like France, Italy has a large agricultural sector and thus has tended to be a net recipient. Unlike France, however, its economy is more domestically oriented. The United Kingdom is a relatively recent member of the European Community. It has a relatively small agricultural sector, and, like Germany, is a net contributor.

Accounting for more than 50 percent of each economy's gross domestic product, services are the largest sector in all four countries, followed by manufacturing, which varies between 20 to 27 percent. Agriculture is typically small, but when considered along with the closely allied food-processing sector, the two account for 6 to 10 percent in each economy. Note that most of the agricultural trade protection in the Community is on processed products such as cheese, wine, and sugar which are classified as food and beverages by the national accounts.

Large- and Small-Scale Farming

The bulk of farm output is produced by a few large farms. Farms over 50 hectares in size account for no more than 6 percent of all farms (Commission of the European Communities 1985c, 83). Ranking farms in terms of their economic size, approximately half of the output is produced by the 10.5 percent largest farms.

In the EC-10 the agricultural labor force declined by 2.5 million between 1973 and 1983—a 24 percent fall (Stoeckel 1985). By comparison, in Australia—where assistance to the rural sector is negligible—farm employment has decreased by only 6 percent. We propose that the large reduction in the rural labor force in the Community happened as a result of the structural adjustments induced by its agricultural policies. The reduction reflects a significant amalgamation of a large number of small, suboptimal farms and, at least until 1973, the relative attractiveness of employment opportunities outside agriculture.

From 1973 to 1983 there was a 24 percent reduction in agricultural employment in the EC-10, as shown in table 3.1. It is very important to try to account for this very large drop in agricultural employment, as well as the large increase in average farm size, when simulating the effects of agricultural policies on the agricultural sector.

If a homogeneous agricultural sector producing a homogeneous product under constant returns to scale is specified, then simulating protection for such a sector would result in increased use of all primary and intermediate

Table 3.1 Reductions in Agricultural Employment in Selected EC Countries between 1973 and 1983

	West Germany	France	Italy	U.K.	EC-10
Decrease in thousands of jobs	553	609	946	100	2490
Decrease in %	29	26	27	14	24

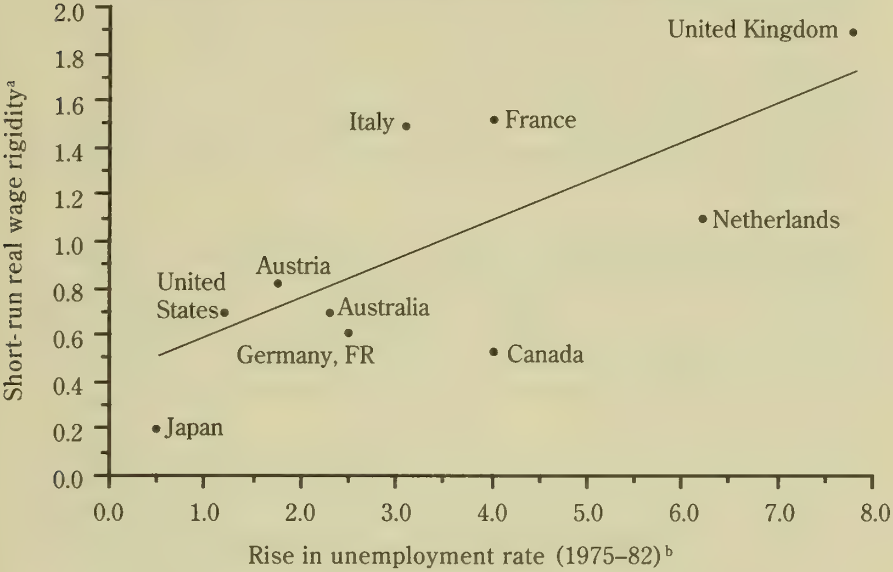
factors of production and thus farm employment. However, the opposite has happened, the reason lying in the technology change and the diverse structure of the rural economy. Detailed specification of this dual agricultural sector is described in Breckling, Thorpe, and Stoeckel (1988). From the results of this study, it can be deduced that the specification of the agricultural sector is important when simulating the effects of the CAP on large and small scale farms. But, more important for this study, it does not have a material bearing on the aggregate agricultural sector nor on the nonagricultural sectors. Also, even though there has been a large exodus of employment from agriculture, principally from the much more numerous small farms, the results suggest that this does not have a large effect on the aggregate employment results. In essence, it is important to consider the differences between large and small scale farming. This is particularly important for policy purposes, since a large number of small holdings consist of part-time farmers, that is farmers who have other sources of income. However, aggregate nonagricultural effects are not sensitive to this heterogeneous structure of European farming.

Labor Market Rigidities

One of the most significant distortions and intractable problems in the EC is the real wage rigidity and high unemployment in the economy. The evidence for this real wage rigidity was described as follows:

> Unemployment remains one of the major economic problems of the Community. The unemployment rate has averaged around 11 percent over the past three years in the EC-10 and is expected to remain around that level in 1987. The increase in unemployment between 1975 and 1982 was most severe in the United Kingdom. While many possible explanations have been advanced for this unemployment, the most widely accepted explanation appears to be rigidity of real wages. (Commission of the European Communities 1985b, 1986)

Figure 3.2 Short-run Real Wage Rigidity and Unemployment



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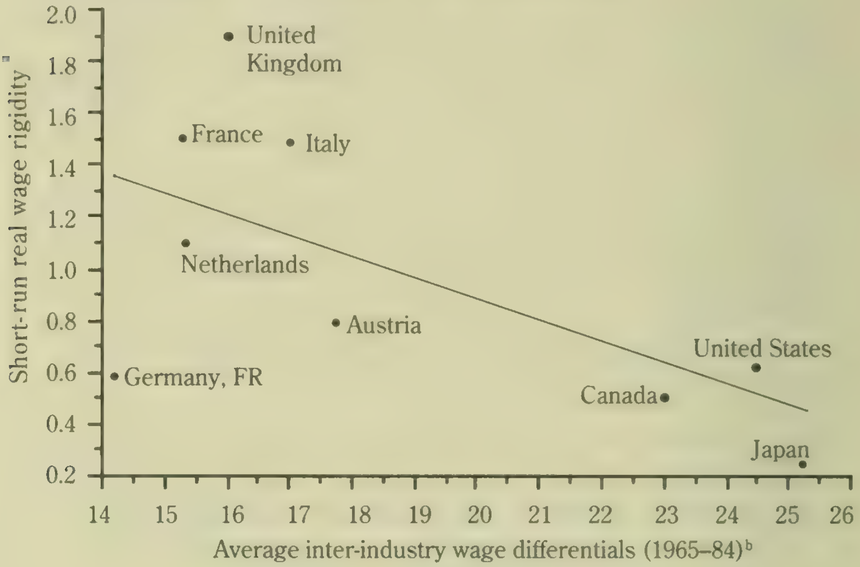
[a] The measure of real wage rigidity used is the short run elasticity of nominal wages with respect to prices divided by the elasticity of nominal wages with respect to the unemployment rate.

[b] Percentage points.

Source: Klau and Mittelstädt (1986).

The degree of labor market inflexibility, both at the aggregate and microeconomic level, and its consequences in OECD countries have been analyzed by Klau and Mittelstädt (1986). The authors derive a relationship between real wage rigidity and unemployment over the short term (during the period from 1975 to 1982), as shown in figure 3.2. The United Kingdom, France, and Italy are estimated to have the highest real wage rigidities of all OECD economies. The United Kingdom has also experienced the largest rise in the unemployment rate. In Germany, however, real wage rigidity is low despite narrow wage differentials reflecting minimum wage legislation and cost-of-living adjustments. Figure 3.3 shows the relationship between aggregate short-run wage rigidity (on the vertical axis) and microeconomic wage rigidity, which is inversely related to average interindustry wage differentials (on the horizontal axis).

Figure 3.3 Real Wage Rigidity and Wage Differentials



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[a] The measure of real wage rigidity used is the short run elasticity of nominal wages with respect to prices divided by the elasticity of nominal wages with respect to the unemployment rate.

[b] Based on hourly wage earnings for time worked for manufacturing industries, except for Japan where only total labor costs were available.

Source: Klau and Mittelstädt (1986).

The labor market rigidities are not confined to the easily observed direct labor costs. In describing the lower efficiency of investment in the Community compared to the United States, and the fact that the real product wage exceeded the increase in total factor productivity, the Commission of the European Communities (1984a, 90) stated:

> It is therefore difficult to avoid the conclusion that the capital-deepening in the EC and the loss of investment efficiency since 1973 by and large represent the response of the enterprises to the rapid rise in direct and indirect labor costs (including social security contributions) and to emerging labor market rigidities which have entailed an increase in the (invisible) costs of labor related to hiring, firing, training, etc. . . . the data . . . sug-

> gest that the real product wage in the EC over the whole period 1960–81 rose, annually, by about 1 percentage point more than the rate of growth of total factor productivity.

These indirect labor costs at the interfirm level are most apparent in Germany. Employment has improved in recent years in the Federal Republic of Germany; this is related to the relative increase in economic activity in that country.

This unemployment problem in Europe has been so great that it is given as the main impediment to reform of agricultural policies. For example, Frans Andriessen, former commissioner for agriculture in the European Commission, is reported as saying, "It is my conviction that if we allowed the market to operate, we would lose millions of farmers and the economy would be charged with the burden of supporting them" (*Australian Financial Review* 12 March 1987).

The Commission of the European Communities (1987, paragraph 121) wrote, "Today the economic scene has changed considerably. Given a total unemployment level of some 17 million persons in EUR-12, . . . the redundant farm worker is now more likely to be found among the ranks of the unemployed."

But the earlier work by Stoeckel (1985) and Breckling, Stoeckel, and Thorpe (1987) suggests the opposite is more likely to be true: that jobs are being lost as a consequence of agricultural policies. Despite the importance of this issue, there has been little attention given to it. The unemployment problem and real wage rigidity is therefore an important part of this study.

Model Features

The model used in this study was developed by Breckling, Thorpe, and Stoeckel (1988). It is best described as a linearized Heckscher-Ohlin general equilibrium model comprising four countries and four sectors of production. The four countries considered are the Federal Republic of Germany, France, the United Kingdom, and Italy, which together account for about 86 percent of the Community's (EC = 10) total gross domestic product. For each of these economies four sectors of production are distinguished: agriculture, food processing, other manufacturing, and services. The agricultural sector has been further disaggregated into small- and large-scale subsectors in accordance with the heterogeneous structure of European farming.

Given the coordination and central administration under the Common Agricultural Policy, agriculture is treated as a homogeneous Community enterprise in this study. The market for an agricultural product need not clear in an individual country but it clears at the EC level, and prices are linked in EC currency after allowing for a price differential to represent monetary compensatory amounts (MCAs). With this exception, all commodities are distinguished by country of origin as well as country of destination. In addition, it is assumed that each country is large enough to influence the world price of its traded goods.

The primary factors available in the production processes are general labor, family farm labor, land, and capital. Family labor, land, and capital are used on both small and large farms. General labor, however, cannot be employed on small farms. The two farm subsectors therefore compete for all factors of production except general labor. Family labor and land are also specific to the agricultural sector. Given these constraints, factors are assumed mobile within each economy but not between countries. While both types of labor can be unemployed, all other factors are fully employed. Furthermore, savings and new investments are not included in the model.

The main behavioral postulates are those standard to general equilibrium models. Producers minimize costs subject to technological constraints. Each sector uses primary and intermediate factors and produces a single commodity. Competitive conditions ensure that all factors except labor receive their marginal products, while returns to general labor are fixed to reflect the presence of real wage rigidities. To represent household behavior, it is assumed that there is a single consumer in each country who minimizes expenditures given the level of utility. A highly simplified version of the model, which provides a detailed discussion of the main driving forces and underlying principles, is contained in Breckling, Thorpe, and Stoeckel (1986).

The price support measures listed in appendix A are captured in this model by combinations of import tariffs, export subsidies, production subsidies, and a uniform consumption tax to fund EC expenditures. Since this study focuses on the removal of CAP price support, all exogenous shocks are directed at the agricultural and closely related food-processing sectors, with all other exogenous variables, including factor resource endowments, held unchanged. For the effects of a full, sectorwide liberalization in Germany, the reader is referred to chapter 4 in this volume.

Liberalizing Agricultural Protection

One of the difficult tasks in any simulation design is to represent the myriad of interventions into supply and demand such that their effects can be traced. One approach is to use measures such as the producer subsidy equivalent (PSE), which capture a range of interventions into a single number. Although PSEs are derived from a partial concept, they do have the advantage that OECD member countries have generally accepted them (OECD 1987).

The PSE combines the transfer payments by both taxpayers and consumers to the combined agricultural and food-processing sector. Estimates of these transfer payments derived by OECD (1987) and BAE (1985) are presented in table 3.2. It can be seen that in 1980 the cost to consumers was much greater than the cost to taxpayers. However, over the last decade the cost to taxpayers has risen at a faster rate than the cost to consumers, though both have steadily increased.

For the purpose of this study, it is assumed that consumer transfers derive from border measures such as tariffs and nontariff barriers (NTBs). Taxpayer transfers, on the other hand, represent value-added tax (VAT) contributions, import levies, direct input subsidies, and deficiency payments and are used to fund export and production subsidies. When estimating the transfers presented in table 3.2, both OECD (1987) and BAE (1985) assumed that imported and domestically produced goods are completely homogeneous. To the extent that they are not, the transfers of CAP intervention have been overstated. We therefore decided to use the slightly more conservative BAE estimates when determining the size of the exogenous shocks. The result is given in table 3.3. For a derivation, the reader is referred to appendix B.

Finally, still concerning the model closure, a comment on the balance of payments is required. The assumption of a current account equilibrium adopted in Stoeckel (1985) and Breckling, Stoekel, and Thorpe (1987) has been criticized by the European Parliament Secretariat (1987). Over time exports and imports in the Community have broadly tracked each other, and it is only in recent times that the Community has moved into surplus. This is principally a result of Germany moving into surplus with the rest of the world (like Japan), while America has accumulated large deficits on its current account. Although from one year to the next large swings can occur, over time the current account will tend to balance and this is what has been assumed in this study. In 1973 exports exceeded imports by only U.S. $10

Table 3.2 Estimates of Taxpayer and Consumer Transfer Payments to Agriculture in the EC (average 1979–1980–1981)

	Taxpayer billion ECU	Consumer billion ECU	Total billion ECU
OECD 1987	21.1	35.8	56.9
BAE 1985[a]	18.7	29.5	48.2

[a] Excluding social security payments.
Sources: OECD (1987, 132), BAE (1985, 100–102).

billion. By 1983 exports had increased by 181 percent while imports had risen by 183 percent. A different closure of the model—for example, a reduction in the agricultural balance together with a deficit on the current account, as suggested by the European Parliament Secretariat (1987)—could easily be implemented. However, since savings and net new investment are held constant in this study, this would imply a domestic deficit, which would in turn imply domestic effects as well, depending on where the extra money was spent.

Simulation Results

To study the effects of liberalizing agricultural protection, the policy scenario described in table 3.3 is imposed on the model. Generally speaking, the consumption tax and production subsidies are domestically oriented, while the other instruments are trade oriented. Hence, given the relative size of the exogenous shocks and the largely domestic orientation of European agriculture and food processing, the simulation results are obviously dominated by the consumption tax and production subsidy effects. For each country the consumer price index was chosen as numeraire so that all price changes can be interpreted as *real.* The results are presented in tables 3.4–3.6. The data base used in this simulation is described in appendix C.

Production and Trade

The main results can be summarized as follows. Mainly because of the removal of the production subsidies, EC agricultural output decreases by 19 percent, while food-processing output falls by an average of more than 13 percent. Agricultural and food-processing exports to the rest of the world (ROW) fall by 66 percent and 56 percent, respectively, while corresponding

Table 3.3 Exogenous Shocks Used in Simulation Study (in percentage)

	Agriculture	Food processing	Whole economy
Consumption tax			−2.0
Import tariff[a]	−0	−9	
NTB	−2	−29	
Export subsidy	−25	−22	
Production subsidy	−18.6	−4.7	

[a] Including NTB equivalents.

imports from the ROW rise by 9 percent and 59 percent. These results largely reflect the effects of trade liberalization and the size of the relevant export demand and import supply elasticities.

The removal of the agricultural production subsidy is associated with a 6.3 percent drop in the price received by producers. Hence, in order to decrease the cost of production, producers must force down the price of those inputs which are used most intensively. Indeed, returns to land and family labor fall by an average of 42 percent and 19 percent, respectively. It follows that those agricultural sectors which are the least intensive users of land and family labor, and thus have the least control over the cost of their production, experience the greatest output contractions. This is true in the United Kingdom and Germany, where production decreases by 32 percent and 26 percent, respectively, while in Italy output declines by only 7 percent.

While large farms experience massive contractions in all member countries, small farms are actually able to expand, the main reason being that the latter are more intensive users of inputs which are specific to agriculture and, as explained above, therefore cheaper. This subsectoral growth differential, which is most pronounced in France, clearly indicates that the production subsidy has had a favorable effect on large farms at the expense of small farms. Furthermore, since small-scale agriculture is an intensive user of family farm labor, its employment prospects are substantially improved. Though at lower wages, employment of family labor increases by 6.6 percent in Italy, 6.2 percent in the United Kingdom, 2.8 percent in Germany, and 2.4 percent in France. This suggests that the CAP has not necessarily secured farm employment, even though agriculture has been its main focus of support. In fact, the opposite appears to be true. As far as small farms are concerned, that is, the advantage of receiving explicit support has been more than outweighed by increased competition from large farms.

Food-processing production decreases for the following four reasons. First,

Table 3.4 EC Aggregate Simulation Results

	Gross output	Exports to the ROW[a]	World price
EC agriculture	− 18.7	− 65.6	32.8

Note: All results are given in percentage change form.
[a] ROW = rest of the world.

the removal of the agricultural production subsidy makes this good more expensive. However, since food processing is an intensive user of agricultural inputs, its cost of production increases. Second, the removal of the food-processing production subsidy means that producers receive a lower price than they would otherwise. Third, the removal of the import tariff makes food-processing goods from the ROW much cheaper so that both consumers and producers are encouraged to switch demand in favor of the ROW product. Finally, removal of the export subsidy makes the domestic product much more expensive on the world market. Production growth differentials between countries therefore largely reflect agricultural input intensities and differences in export shares. As for agriculture, the contraction is greatest in the United Kingdom with 19 percent.

The removal of the agricultural and food-processing production subsidies implies that the price of both products to the consumer—which is equal to the price the producers receive plus the consumption tax minus the production subsidy—rises. The price of the food-processing product rises even further because of increased production costs. Since ROW products become cheaper, consumers will switch demand in favor of these, thus increasing the share of the imported component in effective consumer goods. Given the linearized model with its constant share parameters, however, this effect may have been severely underestimated. The rise in effective consumer prices may therefore be less than suggested by the results presented in this paper.

Whereas food-processing exports from the four countries to the ROW change by roughly the same amount, agricultural export growth figures vary widely. On the one hand, there are virtually no more German and British agricultural exports. On the other hand, exports from Italy actually expand. This reflects the competitive nature of European farming under the CAP, which has been captured in the model by the specification of a common agricultural sector. Concerning agricultural and food-processing imports from the ROW, the figures for the four countries are again fairly similar. Intra-EC trade in food-processing product generally declines.

The rise in agricultural and food-processing imports from the ROW and the drop in corresponding exports cause a devaluation of all member countries' currencies, which amounts to 1.6 percent on average, though it is slightly higher in France at 2.3 percent and slightly lower in Italy at 1.4 percent. Note that only in France and Italy do agricultural export earnings form a significant component of trade accounts. Hence, despite the massive drop of agricultural exports from the United Kingdom and Germany, exchange

Table 3.5 Country-specific Simulation Results (in percentage)

	West Germany	France	United Kingdom	Italy
Gross output				
Small farms	−0.3	16.4	9.8	4.9
Large farms	−62.5	−58.5	−52.4	−41.3
Total agriculture	−25.6	−15.6	−31.6	−7.3
Food processing	−12.2	−12.8	−18.7	−9.6
Manufacturing	1.1	2.1	1.1	0.5
Services	0.5	0.5	1.2	−0.2
Labor movement				
General labor	3.8	4.3	5.5	3.5
Family labor	2.8	2.4	6.2	6.6
Income				
Maximum	−0.9	−1.2	−0.9	−1.6
Actual	1.5	1.1	3.1	0.7
Primary factor returns				
General labor	0.0	0.0	0.0	0.0
Family labor	−18.9	−11.1	−33.4	−13.5
Land	−50.1	−32.3	−56.0	−30.8
Capital	−0.7	−0.9	−2.0	−1.5
Price received by domestic producers				
Agriculture	−6.3	−5.6	−6.8	−6.5
Food processing	3.7	4.9	1.4	4.1
Manufacturing	0.2	0.2	−0.2	−0.1
Services	0.1	−0.1	−0.4	−0.3
Domestic consumer demand				
Agriculture	−9.0	−3.1	−5.4	−2.1
Food processing	−6.5	−6.3	−11.3	−5.7
Manufacturing	0.8	0.7	1.4	−0.1
Services	0.5	0.2	−1.3	−0.3
Exports to the ROW				
Agriculture (to the EC)[a]	−162.6	−15.2	−174.1	68.2
Food processing	−56.0	−57.1	−52.5	−57.4
Manufacturing	4.5	6.3	3.9	4.3
Services	6.2	9.6	6.3	6.6

Table 3.5 continued

	West Germany	France	United Kingdom	Italy
Imports from the ROW				
Agriculture	8.8	13.2	4.5	10.2
Food processing	60.4	62.2	53.2	61.3
Manufacturing	−2.6	−3.4	−2.0	−2.7
Services	−2.2	−3.0	0.0	−2.1
Exchange rate	−1.6	−2.3	−1.2	−1.4
Terms of trade	0.3	0.7	1.6	0.5

Notes: All price changes are relative to the country-specific consumer price index. Labor movements are relative to the employed and not the total work force.

[a] These numbers are relative to each country's exports to the EC, with corresponding imports of EC agricultural produce held constant. Changes of < −100% thus can arise, for example, if a country switches from a net exporter of EC agricultural product to a net importer. In the case of Germany, net imports increase by 885 million ECUs, while in the United Kingdom net imports rise by 1.02 billion ECUs.

rates in these two countries overall are no more affected than in France or Italy.

As a result of the devaluations, manufacturing and services exports to the ROW rise by about 5 percent and 7 percent, respectively. Given the export orientation of the manufacturing industry, this sector expands by 1.2 percent Communitywide, while the domestically oriented services sector is less favorably affected. At the same time manufacturing and services imports from the ROW decline by an average of 3 percent and 2 percent, respectively, while intra-EC trade in these commodities reflects relative exchange rate movements.

Employment of General Labor

Given real wage rigidities and the fact that the expanding manufacturing sector is relatively labor-intensive, employment of general labor improves by more than 3.5 percent throughout the Community. It is estimated that 1.4 million persons less would be unemployed in the United Kingdom alone, if agricultural and food-processing protection was removed. The corresponding numbers for Germany, France, and Italy are 1.0 million, 0.9 million, and 0.7 million. Extrapolating these results to the EC-10 on the same pro rata average basis suggests that over 4.6 million persons more could be employed as a result of removing agricultural and food-processing protection.

Had real wages been completely flexible, returns to general labor would have risen by more than 2 percent Communitywide and employment of both labor categories would have remained virtually unchanged, though still showing a significant drop in the price of family labor. However, all other results would have been only marginally affected, since supply response and funding of unemployment benefits have only a small effect on the aggregate economies. The unemployment outcome obtained in this simulation can therefore be largely attributed to real wage rigidities.

Even if in the real world real wages were partly flexible, translated into jobs it can be said that the unemployment consequences of the CAP are highly significant. Given that even in the long term real wages tend to be more rigid than flexible (Klau and Mittelstädt 1986), unemployment is likely to be in the order of two to four million people. Compared with the results reported in Stoeckel (1985) and Breckling, Stoekel, and Thorpe (1987), this is a much higher level of unemployment, primarily because in the current study national government support has been included along with EC budgetary assistance. The fact remains that there is mounting evidence that diverting resources into agriculture does not save jobs but exacerbates the unemployment problem throughout the Community and across all sectors, including agriculture.

Income and Consumption

Largely as a result of increased employment (or increased returns to general labor in the case of flexible wages), aggregate income rises by 1.6 percent on average. Since the agricultural and food-processing sectors form a larger part of the French and Italian economies than they do in the British or West German economies, it is not surprising that these two countries emerge as the main beneficiaries of CAP price support. Whereas in the United Kingdom liberalization causes real income to rise by 3.1 percent, in Italy it results in only a 0.7 percent increase. Nevertheless, all four economies could be better off, though to different degrees, if agricultural and food-processing protection was removed.

Reflecting relative price movements, consumers of agricultural and food-processing goods switch demand in favor of ROW product, while consumers of manufacturing and services goods switch demand in favor of domestic product. Whereas consumer demands for domestic agricultural and food-processing goods decline by an average of 5 percent and 7 percent, respectively, demands for ROW product increase by 18 percent and a massive 65 percent, largely because of trade liberalization. Further, reflecting the rise in real income, consumer demands for domestic manufacturing and service goods tend to increase. Demands for ROW product, on the other hand, fall by 3 percent and 2 percent, respectively, mainly because of the devaluations. That is, demands for domestic goods are largely determined by the consumption tax and production subsidies, while demands for ROW product mirror the effect of trade protection measures.

Money Transfers

In this section the net money transfers between EC member countries are analyzed. The effects of the seven policy instruments used in the simulation are summarized in table 3.6. For each country the value of total export receipts in the base period, which is assumed to be the same as the value of total import expenditure, has been chosen as a reference point against which all changes are expressed in percentage terms. That is, transfers are measured relative to the value total exports would have taken in the absence of any change to the CAP.

The first five rows in table 3.6 represent the four major components in each country's trade balance, that is, value of exports, value of imports, the consumption tax, and the two production subsidies. These rows therefore add up to zero, provided the signs are set appropriately. Consequently, standard trade accounts, excluding the consumption tax and production subsidy components, can be in deficit or surplus. Export subsidy receipts and import tariff revenue, on the other hand, do not explicitly appear in the individual trade accounts. Combining the effect of the seven instruments, the net transfers give an indication of the extent to which each economy is affected by the CAP.

France and, more particularly, Italy are the main beneficiaries of the agricultural production subsidy, since their agricultural sectors form a much larger part of their economies. The agricultural production subsidy, funded by a consumption tax of appropriate size, amounts to a net money transfer from the United Kingdom and Germany to Italy and France. The food-processing production subsidy causes a transfer in the same direction, though of smaller magnitude, as food processing is about equally important in the four economies.

Agricultural trade support also involves a net transfer from Germany and the United Kingdom to France and Italy. However, here it is France rather

Table 3.6 Inter-EC Transfers

	West Germany	France	United Kingdom	Italy
Transfers				
Value of exports	2.9	2.5	0.5	5.2
Value of imports	3.8	1.4	3.3	2.2
Consumption tax	−8.8	−10.8	−8.7	−10.2
Production subsidy on agriculture	−5.4	−9.0	−3.6	−10.0
Production subsidy on food processing	−2.5	−2.9	−2.3	−3.2
Import tariff on agriculture	−0.1	−0.0	−0.1	−0.0
Import tariff on food processing	−1.9	−1.6	−3.6	−2.1
Export subsidy on agriculture	0.3	−1.3	−0.0	−0.1
Export subsidy on food processing	−0.4	−0.9	−0.7	−0.2
Net transfers	2.8	−1.7	5.8	−1.2

Note: For all intra-EC transfers, the value of total export receipts in the base period has been chosen as a reference point, against which all entries are expressed in percentage terms.

than Italy which is the main beneficiary, and Germany rather than the United Kingdom which carries the major burden. Because of the importance of the French agricultural export sector, France is the main recipient of export subsidy assistance. Germany and the United Kingdom, on the other hand, both being significant importers of agricultural product, miss out on the import tariff receipts, which are levied by the EC and not passed on to them.

Food-processing trade support, however, causes a net money transfer from Italy and the United Kingdom to France, leaving Germany largely unaffected. The United Kingdom and Italy are the main contributors to this part of the EC budget, while France and to a lesser extent the United Kingdom are the main recipients. Thus France is the main beneficiary and Italy is the main loser of the food-processing export subsidy combined with a corresponding tariff. As evident from table 3.6, these net transfers can be equivalent to more than 4 percent of a country's total gross export earnings.

In summary, France, gaining under each scenario, clearly benefits from the CAP, while the United Kingdom, losing under each, carries the major burden, as indicated in table 3.6. Although Italy is slightly disadvantaged by the trade protection measures, it is the main recipient of the production subsidies. Given that these are more important than trade support, Italy too emerges as a beneficiary of CAP price support. Germany, like the United Kingdom, is a net contributor, mainly because of agricultural protection. Trade in general is adversely affected by the CAP, with the value of both total exports and total imports being reduced in each country. If protection was removed, the terms of trade would improve throughout the Community, though most significantly in the United Kingdom by 1.6 percent.

It is acknowledged that an adjustment for the linearization approximation would have changed some of the results in this section, particularly on the trade side. It can be shown, however, that the main results, including the level of unemployment, income loss, and net money transfers, would have been affected only marginally.

Conclusions

The findings of this study show that the agricultural policies of the European Community impose costs which are much greater than the direct and visible budgetary costs. Although the combined agricultural and food-processing sector does not account for more than 10 percent in any of the four major economies, there are significant costs to the other sectors in the EC. This is because the rate of agricultural protection in the EC is among the highest observed for any sector anywhere in the world. As this study indicates, the adverse effects associated with the CAP may be summarized as follows:

- The support afforded the agricultural and food-processing sectors does not save jobs. Rather, it exacerbates the unemployment problem in other sectors and in the Community as a whole.
- It is estimated that employment in the EC-10 is reduced by two to four million people. The employment consequences are most severe for the United Kingdom where up to 1.4 million more people could be employed if agricultural protection were removed. The corresponding numbers for Germany, France, and Italy are 1.0 million, 0.9 million, and 0.7 million, respectively.
- The support provided under the CAP may have led to a contraction of particular agricultural subsectors. In fact, most of the assistance goes to large farms, causing small farms to decrease production. It thus appears that the CAP worsens unemployment within the agricultural sector also.
- The manufacturing industries (apart from food processing) suffer significant contraction throughout the Community and hence are the main losers from the CAP.
- There are significant transfers between member countries, with the United Kingdom and Germany carrying the burden, and France and Italy being the beneficiaries.

Compared with the studies by Breckling, Stoeckel, and Thorpe (1987) and Stoeckel (1985), these results show that national government support has an adverse effect on the other sectors of the Community equal to that of EC budgetary assistance.

The Community has made a conscious decision to increase agricultural output. It has done this by diverting resources from other areas, thus reducing growth in these areas below their potential, and by encouraging significant growth in agricultural exports, mostly at a loss. Had the Community chosen not to direct research and other resources into agriculture, these resources could have been used in areas where world demand has grown strongly. Had they done so, the economic growth rates in the United Kingdom and Germany, the level of manufacturing and services exports, and the EC share of those exports in world trade would be greater today. By concentrating resources in agriculture, an area where the Community has not traditionally had a comparative advantage and where it is unlikely to gain a comparative advantage in the future, the Community has had to pay a high price.

These results show that agricultural protection has cost jobs, rather than saved them as had been asserted by the EC Commission. Contrary to the main reason given for the lack of reform, namely that jobs would be lost, the opposite, in fact, is more likely to be true. Reform of agricultural policies in the EC would enhance job prospects and would increase manufacturing output and manufacturing exports.

Appendix A. Objectives and Instruments of the CAP

The objectives of the Common Agricultural Policy were set down at the formation of the Community in Article 39 of the Treaty of Rome, 1957 (see BAE 1985). As summarized in Breckling, Stoeckel, and Thorpe (1987), the objectives of the CAP are to promote technological and productive efficiency, support farm incomes, provide stable prices, and assure food supply. A vast array of instruments has been used to achieve these objectives. The basic principle is a unified agricultural market. This has primarily been achieved through CAP price support and by permitting free trade within the Community's agricultural sector, with members sharing joint budgetary responsibility (BAE 1985).

CAP price support is based on three price differentials for agricultural products: between EC countries and the rest of world, between EC countries themselves, and between EC producers and consumers. More specifically, the price support measures can be summarized as follows:

- *Intervention purchasing arrangements.* Government or semigovernment agencies purchase commodities to prevent their market prices from falling below specified intervention prices.
- *Variable export subsidies.* These bridge the gap between internal market prices and prices that can be obtained for exports to the rest of the world. Within the Community these subsidies are also known as export refunds or restitutions.
- *Budgetary assistance.* Paid for either by the Community or national governments, this assistance is for farm restructuring, research and technological development, and input subsidies. In addition, some national governments provide subsidies for output. All of these assistance measures have the effect of increasing the supply of agricultural products.
- *Variable levies.* Imports of both agricultural and food-processing products are subject to levies to ensure that they do not enter the Community at prices that may circumvent the effects of domestic support policies.
- *Monetary compensatory amounts (MCAs).* These exist to ensure that some products do not flow across national boundaries at prices that might "disrupt" production in EC members as a result of varying exchange rates. The MCAs can be either positive or negative and therefore act as either export taxes or import subsidies.
- *The consumption or value-added tax (VAT).* Currently, the fixed statutory maximum of the tax is 1.4 percent of the base on which the VAT is levied. The tax provides the main revenue source to fund EC expenditure on agriculture.

In addition to these price support measures, the Community has adopted production quotas and quantitative import restrictions as instruments of agricultural support.

In most years, assistance provided to the agricultural sector by the variable import levies has exceeded that provided directly by the Community or national governments. Because the impact of the variable import levies depends on the disparity between the domestic and international prices of agricultural products, the levy component of the assistance package has tended to fluctuate considerably over time. Nevertheless, the trend has been upward since 1971–72.

Appendix B. Derivation of the Exogenous Shocks

As shown in table 3.2, the cost to taxpayers of agricultural support in 1980 was estimated at 18.7 billion ECU (bECU). This amount consists of 9.2 bECU raised by the centralized budgetary authority of the Community and 9.5 bECU from national governments (BAE 1985, 102). Hence, national government support, excluding social security benefits, was of the same order of magnitude as that financed by the EC budget. EC revenue is raised mainly from VAT contributions, agricultural and food-processing import levies, and other customs duties. Since the latter were held constant in the model, the other revenue figures had to be adjusted such that EC expenditures could be financed. This procedure led to 7.2 bECU raised from the VAT and 2.0 bECU from import tariffs.

While EC revenue is spent about evenly on export restitutions and other intervention measures—mainly storage and aids to producers, processors, and marketers (BAE 1985, 103)—domestic support falls almost entirely into the second category. Table 3B.1 gives a breakdown of EC expenditure in 1980, as derived from the financial report on the European Agricultural Guidance and Guarantee Fund (BAE 1985, 64).

For the purpose of this study, it is assumed that storage aids are implicit export subsidies and that other intervention expenditure—basically price compensatory measures—is captured by a production subsidy. This implies that taxpayer transfers can be allocated as in the last row of table 3B.2. Furthermore, it is assumed that national government expenditure on agriculture and food processing is funded from general taxes, which are collected in the same way as the VAT. While the VAT ceiling for the EC budget was 1.0 percent in 1980, to fund both national government and EC expenditures consumers in the Community were effectively confronted with a uniform consumption tax of 2.1 percent. This raises 16.7 bECU, with the remaining 2.0 bECU coming from import levies.

Taking the values of agricultural and food-processing production, exports, and imports (Commission of the European Communities 1984b, 188–95, 253), support provided under the CAP can be quantified as in the last two columns of table 3B.3.

So far, agriculture and food processing have been treated as a combined sector, although CAP support of the two industries differs widely. As evident from table 3B.2, nontariff protection is much greater for food processing than for agricultural products, while production aids are generally greater for

Table 3B.1 EC Expenditure by Sector and Economic Category in 1980

	Export Refunds bECU	Intervention measures			Total Expenditure bECU
		Storage bECU	Other aids bECU	Total bECU	
Agriculture	1.8	0.2	1.3	1.5	3.3
Food processing	2.8	1.1	2.0	3.1	5.9
Combined	4.6	1.3	3.3	4.6	9.2

Source: BAE (1985, 64).

the latter. It is therefore necessary to disaggregate the assistance measures into agricultural and food-processing components. Estimates of relative PSEs for all major agricultural and food-processing commodities are obtained from OECD (1987, 117). Given the share of these commodities in total production (Commission of the European Communities 1984b, 190), the total PSE of 48.2 bECU can then be divided between agriculture and food processing, as indicated in the last column of table 3B.2.

Total EC expenditure under the Guarantee Section on agriculture and food processing has been disaggregated by product in the report by BAE (1985, 64). Further, referring to the Commission of the European Communities (1984c, 30), 80 percent of domestic support is directed towards agriculture and only 20 percent towards food processing. This implies that 10.9 bECU of the taxpayer's contribution of the 18.7 bECU are spent on agriculture and 7.8 bECU on food processing. Disaggregated consumer transfers are then obtained residually, yielding the figures presented in table 3B.2. If follows that consumer transfers are much greater for food processing than for agriculture, reflecting the greater nontariff protection of the former sector, as mentioned above.

Referring to BAE (1985, 64), expenditure on storage and export restitutions can be disaggregated in exactly the same way as total taxpayer trans-

Table 3B.2 PSEs for Agriculture and Food Processing

	Taxpayer				
	Export subsidies bECU	Production subsidies bECU	Total bECU	Consumer bECU	Total bECU
Agriculture	2.0	8.9	10.9	1.0	11.9
Food processing	3.9	3.9	7.8	28.5	36.3
Combined	5.9	12.8	18.7	29.5	48.2

Table 3B.3 Estimated Relative Size of Agricultural and Food-processing Protection Measures (in percentage)

	Agriculture	Food processing	Combined	Whole economy
Consumption tax				2.1
Import tariff	0.3	9.6	4.9	
NTB	1.7	41.1	22.8	
Export subsidy	33.9	28.8	30.4	
Production subsidy	22.8	4.9	10.9	

fers. By residually determining the amount spent on other production enhancing measures, tables 3B.1 and 3B.2 are completed. Finally, assuming that the tariff revenue from agricultural and food-processing products is raised in exact proportion to the corresponding NTBs, it is possible to derive the size of the CAP-induced distortions, as listed in the first two columns of table 3B.3. Finally, in order to simulate the effect of trade liberalization, these protection measures need to be removed, yielding the simulation package presented in table 3.3.

When estimating the figures presented in table 3B.3, it was assumed that the entire amount raised domestically goes into agricultural and food-processing production. However, to the extent that these funds are not used efficiently, the production subsidy figures have been revised downward by 16 percent, which at the same time ensures a balanced EC budget. As in Breckling, Stoeckel, and Thorpe (1987), monetary compensatory amounts are held constant. It is also assumed that the EC expenditure constraint and all individual trade accounts remain unchanged, in accordance with the long-run framework adopted in this study and also consistent with the historical evidence of an unchanged net trade position for the Community in aggregate (Commission of the European Communities 1986, 22).

Appendix C. Data Base

The major source for the share parameters associated with the equilibrium position was the *Standardized Input-Output Tables of EEC Countries for Years Around 1975* (United Nations 1982). These data were augmented by 1980 trade shares obtained from OECD trade tapes used in the INTERLINK Model (OECD 1983). Country-specific unemployment figures were obtained from OECD statistics for 1979 (OECD 1985). The ratio of unemployment benefit to employment wage was set to 0.5 for all countries. The

Table 3C.1 Key Behavioral Elasticities

Description	Best guess
Production substitution elasticities (CES)	
Between commodities and primary factors for all countries	0.8
Production and consumption elasticities	
Between domestic and imported goods for all countries	
Agricultural products	3.0
Food-processing products	3.0
Manufacturing products	4.0
Services goods	2.0
Consumer income elasticities	
Agricultural products for all countries	0.2
Food-processing products for all countries	0.4
Manufacturing products for all countries	0.8
Services goods[a]	
West Germany	1.16
France	1.15
United Kingdom	1.15
Italy	1.21
General labor leisure demand	2.0
Family farm labor leisure demand	2.0
Export price elasticities of ROW demand	
Agricultural and food-processing products for all countries	2.0
Manufacturing products for all countries	3.0
Services goods for all countries	4.0
Import price elasticities of ROW supply	
Agricultural and food-processing products for all countries	4.0
Manufacturing products for all countries	4.0
Services goods for all countries	5.0

[a] These settings ensure that the weighted sum of expenditure elasticities is unity in each country.

input-output shares of the agricultural subsectors were derived from the Farm Accountancy Data Network (Eurostat 1982). Small farms were defined as those producing less than 16,000 ECU and large farms as those producing this amount or more. Further details on the data base are provided in Breckling, Thorpe, and Stoeckel (1988).

Behavioral elasticities were taken from studies by Whalley (1985); Stern, Francis, and Schumacher (1976); and Deaton and Muellbauer (1980). Table 3C.1 provides a list of the elasticities used in the study. Even though the estimates vary considerably, the sensitivity analysis reported in Breckling, Thorpe, and Stoeckel (1988) shows that, except on the trade side, most results are fairly robust and that the effects on the domestic economies are negligible.

In the simulation study described in Breckling, Thorpe, and Stoeckel (1988), an elasticity of substitution between domestic and imported agricultural and food-processing product of 1.0 was chosen. Even though this caused the world price of ROW product to rise and the domestic price of the same good to drop sharply, the price of EC product was hardly affected despite the size of the substitution elasticity. The reason for this is that the share of ROW product in the corresponding effective commodities is so small that agricultural and food-processing products could almost be regarded as nontraded items. It is argued, however, that these shares are so small because of the protection and that they would be much greater in the absence of the CAP. The substitution elasticities were therefore set to 3.0 so that the implicit import demand elasticity takes a more realistic value. By the same token, the import supply elasticities were also slightly revised.

References

Anderson, K., and R. Tyers. 1988. *Effects of liberalising trade in agriculture.* Thames Essay no. 55. London: Trade Policy Research Center.

Breckling, J., A. Stoeckel, and S. Thorpe. 1987. *Effects of EC agricultural policies: A general equilibrium approach—initial results.* Canberra: BAE and Centre for International Economics.

Breckling, J., S. Thorpe, and A. Stoeckel. 1986. A skeletal version of a general equilibrium model for the European Community. BAE paper presented at the Australian Meeting of the Econometric Society, 28–30 August, Univ. of Melbourne.

Breckling, J., S. Thorpe, and A. Stoeckel. 1988. *ECSIM: A general equilibrium model for the European Community.* Canberra: Australian Bureau of Agricultural and Resource Economics.

Bureau of Agricultural Economics (BAE). 1985. *Agricultural policies in the European Community: Their origins, nature, and effects on production and trade.* Policy Monograph no. 2. Canberra: Australian Government Publishing Service.

Clements, K. W., and L. A. Sjaastad. 1984. *How protection taxes exporters.* Thames Essay no. 39. London: Trade Policy Research Centre.

Commission of the European Communities. 1984a. European Economy no. 22. Brussels.

Commission of the European Communities. 1984b. *The agricultural situation in the Community: 1983 report.* Brussels.

Commission of the European Communities. 1984c. *Public expenditure on agriculture* CEC. Working Document.

Commission of the European Communities. 1985a. *Perspectives for the Common Agricultural Policy.* COM(85) 333 (final). Brussels.

Commission of the European Communities. 1985b. European Economy no. 25. Brussels.

Commission of the European Communities. 1985c. *The agricultural situation in the Community: 1984 Report*. Brussels.

Commission of the European Communities. 1986. European Economy no. 30. Brussels.

Commission of the European Communities. 1987. *The agricultural situation in the Community: 1986 Report*. Brussels.

Deaton, A., and J. Muellbauer. 1980. *Economics and consumer behaviour*. Cambridge: Cambridge Univ. Press.

Dicke, H., J. B. Donges, E. G. Gerken, and G. Kirkpatrick. 1988. Economic effects of agricultural trade liberalization in West Germany. Chapter 4 of this volume.

Duchene, F., E. Szczepanik, and W. Legg. 1985. *New limits on European agriculture: Politics and the Common Agricultural Policy*. A research volume from the Atlantic Institute for International Affairs. Totowa, N.J.: Rowman & Allanheld.

European Parliament Secretariat. 1987. *A reply to some criticisms of the CAP*. Research and Documentation Papers, Agricultural Series no. 16. Strasbourg.

Eurostat. 1982. *Farm accountancy data network*. Luxembourg. Microfiche.

Eurostat. 1984. *National accounts ESA: Detailed tables by branch*. Luxembourg.

Gerken, E. G. 1986. *The determinants of European agricultural trade interference*. Kiel Working Paper no. 254. Kiel: Institute of World Economics.

Klau, F., and A. Mittelstädt. 1986. Labour market flexibility. OECD Economic Studies no. 6 (Spring): 7–45. Paris.

OECD 1983. *The OECD interlink model*. Paris.

OECD 1985. *OECD Economic Outlook*, no. 38. Paris.

OECD 1987. *National policies and agricultural trade*. Paris.

Spencer, J. 1986. The European Economic Community: General equilibrium computations and the economic implications of membership. In *New developments in applied general equilibrium analysis*, ed. J. Piggott and J. Whalley. Cambridge: Cambridge Univ. Press.

Stern, R., S. Francis, and B. Schumacher. 1976. *Price elasticities in international trade: An annotated bibliography*. London: Macmillan.

Stoeckel, A. 1985. *Intersectoral effects of the CAP: Growth, trade and unemployment*. BAE Occasional Paper no. 95. Canberra: Australian Government Publishing Service.

United Nations. 1982. *Standardized input-output tables of EEC countries for years around 1975*. Statistical Standards and Studies no. 34. New York.

U.S. Department of Agriculture. 1987. *Government intervention in agriculture: Measurement, evaluation, and implications for trade negotiations*. Foreign Agricultural Economic Report no. 229. Washington, D.C.

Whalley, J. 1985. *Trade liberalisation among major world trading areas*. Cambridge, Mass.: MIT Press.

Winters, L. A. 1987. The economic consequences of agricultural support. OECD Economic Studies no. 9 (Autumn): 7–54.

4. Effects of Agricultural Trade Liberalization on West Germany's Economy

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Summary

The Common Agricultural Policy (CAP) of the European Community (EC) has come to a deadlock. It is financially unsustainable; farmers are deeply dissatisfied with their income levels; the general public is concerned about chronic and growing domestic production surpluses; trade disputes with nonmember temperate countries over import barriers and dumping are more serious than ever; signs of political antagonism between member state governments are mounting. A fundamental reform of the CAP and associated national policies, based on market principles, is overdue. Such reform still meets with stiff opposition in politically influential circles in Germany, in particular from the Farmers Federation.

Agriculture in Germany accounts for less than 2 percent of the gross domestic product and employs roughly 5 percent of the total labor force (3 percent in full-time equivalents). It is one of the highly protected sectors which has received government assistance for decades (other highly protected activities include coal mining, iron and steel, textiles and clothing, aircraft and aerospace, railways). Currently, total public subsidies to agriculture amount to well over DM 20 billion, equivalent to about 70 percent of this sector's gross value added at domestic prices. More than half of these subsidies stem from German sources (though officially considerably less is defined as subsidy). The impact of these German subsidies is largely to increase, or

at least maintain, production. Thus the role of national policies within the framework of the CAP is quite significant indeed.

The counterpart of farm subsidies is the financial burden placed on German taxpayers, with the exception of farmers, who pay only around DM 1.5 billion a year. Another direct cost which Germany's nonfarm community has to bear results from the effect of protective devices on domestic prices of agricultural products: these prices are raised well above world market levels —for instance, by about 50 percent on average during 1978–81. It is by no means certain that the gains to farmers exceed the losses to taxpayers and consumers; the opposite is much more likely.

According to government reports, the farmers' gains through price support and subsidies have not satisfied the income objectives for the farm sector. However, the economic situation of German farmers is much better than asserted. First, farm households earn as much income from nonfarm activities as from agricultural production: 40 percent of the farms are operated on a part-time basis and those farmers with permanent jobs in other sectors seem to be, on average, better off than full-time farmers. Second, since most German farmers are also landowners they additionally benefit from the increase in land prices induced by the agricultural policies; this, however, has widened the wealth gap between rich and poor farmers.

The distorting effects of high agricultural prices artificially induced by policy are not confined to the producers and do not only cause real income losses to taxpayers and food consumers. The whole German economy is affected. The policy removes the links between relative internal prices of productive factors, as well as that between tradable and nontradable goods and their relative scarcities and demand structures. Therefore, too much land, labor, capital, and entrepreneurship is kept in agriculture, although these resources could achieve a higher productivity elsewhere. The income and price effects lead to the movement of resources away from less protected nonagriculture sectors; these sectors are also harmed by the protection-induced appreciation of the exchange rate for the deutsche mark. To put it another way, the policy intended to help farmers in fact constitutes a tax on Germany's growth and export industries.

Given the economywide costs associated with present agriculture policies, the question which suggests itself is, What would happen to the German economy as a whole if agricultural protection were removed? We estimated the effects of agricultural liberalization using an applied general equilibrium model of the German economy. The model comprises thirteen sectors reflecting the variety of public assistance in Germany. The base data are for 1980 and the numerical results refer to the medium run.

Estimates in this study show that agricultural liberalization would increase both skilled and unskilled employment by around 4 percent (850,000 workers in 1987 terms) and the real gross domestic product by more than 3 percent, relative to the status quo. The employment effect would reduce the rate of unemployment from its 1987 level of about 9 percent to 5 percent. Output would be higher in all sectors but agriculture and food processing. This higher output would be accompanied by an even greater increase in foreign trade (around 5 percent in real terms). That the expansionary effect would fall notably more on trade than on output is an indication of the significant welfare gains arising from liberalization that the German society would enjoy.

Important changes in the commodity composition of trade would occur, moving away from agricultural products towards the investment goods industry, in which Germany has a distinct comparative advantage. Agriculture and food processing would experience a rise in real net imports (by 65 and 70 percent, respectively), whereas mechanical and electrical engineering would improve their net export positions (by 12 and 16 percent, respectively).

Simulation results also show that the economywide benefits of policy reform in agriculture could be increased if liberalization was extended to other sectors with high protection in Germany. Then the positive employment effect would amount to 11 percent, or the elimination of current unemployment levels; the positive overall output effect would be 9 percent; and the positive foreign trade effect would be 26 percent. This said, the increased demand for skilled labor could well run up against supply bottlenecks. The ability to alleviate such shortages would influence the extent to which the potential employment gains of both agricultural and full liberalization could be realized.

As expected, the loser in an agriculture liberalization scenario would be the agricultural sector itself. Reductions in employment and output in agriculture would be on the order of 24 percent; land rentals would suffer a decline of 17 percent, to which must be added a drop in the value of other sector-specific assets such as buildings and livestock. A hypothetical full liberalization would result in even more adverse consequences for agriculture. This may be the root cause of the fierce resistance within Germany's farming community to the badly needed policy reform. In order to overcome this resistance, it may be necessary to compensate farmers financially for these one-off wealth losses. After all, not only would the German economy as a whole (let alone other agriculture-oriented countries) be better off, but so would German farmers, who would then have the choice to do something else, whether in forestry, industry, or services, whether in rural or nonrural areas.

Introduction

West German agriculture is a highly protected economic activity. The array of policy measures shielding the sector from competitive pressure in markets for goods, capital, and labor is wider and the burden taxpayers and consumers have to suffer is heavier than in most other protected industries. To be sure, farmers have a political influence disproportionate to their number; the proportion of agricultural employees (full-time equivalent) in the total labor force amounted to roughly 3 percent in 1986 (compared to 8 percent in 1960). Abroad, Germany is regarded as one of the strong remaining opponents to a market-oriented reform of the Common Agricultural Policy (CAP) of the European Community (EC), even though this contradicts its liberal-minded trade policy stance in other areas and its professed awareness of the virtues of a functioning price mechanism.

The support to West German agriculture, as with agriculture in the other EC countries, is provided under the auspices of the CAP. However, the CAP is not established by an independent supranational agency but by a cooperative process in which the national governments of member states are important players. In this process national governments pursue selfish agricultural policies, notwithstanding that the Treaty of Rome (1957) commits member states not to disturb the functioning of a common market. In Germany the historical roots of these agricultural policies have to be seen in the creation of a cartel of interest groups in the pre-CAP era when the Farm Law ("Landwirtschaftsgesetz") of 1955 was enacted. The law has triggered off programs which benefit German farmers at the expense of both foreign farmers and domestic nonfarmers. In the early 1960s the German agricultural policy-making bodies strongly influenced the negotiations on how the common market for agricultural products should be organized. Indeed, the main features of the European common agricultural market—from the organizational framework to the level and structure of protection—to a large extent resemble the pre-CAP protection of German agriculture. Moreover, the German federal government persisted in raising protection on the national and the EC level, even after it had become evident that this policy was not meeting the declared objectives of agricultural policy but rather was creating notable budgetary and economic costs.

The protectionist policies have been facilitated by the fact that these costs are hardly transparent. However, this is changing because other sectors and, in particular, industrial exporters, are realizing that agricultural protection is associated with economywide costs: higher taxes, a higher valuation of the deutsche mark, and the risk of retaliation by countries which are net exporters of agricultural products. The chance is therefore growing that the cartel of interest groups set up in the early 1950s could dissolve in the not too distant future. Thus, for example, the Federation of German Industry has only recently cautiously supported a reform of the agricultural policies (Bundesverband der Deutschen Industrie 1987), and the Farmers Federation itself is showing substantial internal division. Transparency of the income and employment losses caused by these national and EC policies may help to speed up the institutional change and to pave the way for the overdue radical reform of both the CAP and Germany's domestic agricultural policy.

The purpose of this paper is to contribute to this process by analyzing the economywide costs associated with the present agricultural policies and thereby examine the prospective benefits associated with agricultural liberalization. In the second section, below, we first investigate the direct costs of agricultural support: the budgetary costs and the increased prices paid by consumers. The former in particular is rather opaque. We then analyze the "benefits" claimed for agricultural protection before briefly describing the interest group structure which has led to the present position. In the next section we analyze, by means of an applied general equilibrium model, the prospective benefits and costs from agricultural trade liberalization. The final section presents our conclusions together with observations on the political economy of reform.

Agricultural Policy-Making in West Germany

The Direct Costs

The price which taxpayers and consumers would voluntarily pay for the support of the German farm sector if they had the option is unknown. Even the price which taxpayers and consumers are forced to pay is difficult to establish given the lack of transparency of the measures adopted and uncertainty about the financial cost of tax relief. The number of budget programs directed to the agricultural sector exceeds 400, of which approximately 100 are run by the EC.[1] Based on these programs, the Kiel Institute estimates the subsidies to agriculture to be some DM 20 billion in 1984. Table 4.1 clearly shows that, in contrast to the focus of public attention, only half of the total subsidies directly arise from the operation of the CAP. Moreover, the subsidy report of the federal government refers to national subsidies of "only" DM 3.7 billion in 1984 in contrast to the Kiel Institute's estimate of DM 10.9 billion. Apart from the wider coverage of the latter estimate, a major difference is the treatment of tax relief. As a reaction to the reduction of agricultural support prices decided upon by the Council of Agricultural Ministers, the German government compensated farmers by cutting value-added taxes.[2] Between 1981 and 1985 the total recorded tax relief doubled from DM 2 billion to about DM 4.1 billion; these figures (among others) are not included in the official subsidy report but they are counted as subsidies by the Kiel Institute.

Preliminary estimates for 1985 place the subsidies to the agricultural sector in the order of DM 21 billion, of which DM 8.7 billion was provided by the EC.[3] Even if the taxes paid by farmers are deducted (around DM 1.5 billion a year) the net outlay is still remarkable. In spite of the government's commitment to slowing public spending and to reducing subsidies, real agricultural outlays have in fact further increased. The financial cost per employee amounted to DM 14,500 in 1985;[4] the equivalent sum for the nonfarm sector was DM 4,000. Ranking subsidies per employed person over forty-five industries, agriculture ranks as the fifth highest, exceeded only by sectors such as railways, coal mining, and aerospace (Jüttemeier 1987).

Subsidies to farmers represent only one form of direct cost. The agricultural policy regime also prevents German (and other EC) consumers from buying from the cheapest source in the world; they have to pay, for the benefit of domestic farmers, prices which are notably above those abroad (table 4.2).

Furthermore, owing to many quantitative restrictions on imports, consumers are not allowed to buy the best quality. Apart from quality aspects, the relative agricultural support prices have a strong impact on the consumption structure. For instance, per capita consumption of fresh beef and veal, held to be rather income elastic products, is three times higher in Brazil than in West Germany where the price is double the world level (Kravis, Heston, and Summers 1982). Were there not such an interference through agricultural protection, German consumers would presumably buy high-quality beef

Table 4.1 Subsidy Disbursements to the German Agricultural Sector by Source and Reporting (DM billion)

Source	1973	1974	1980	1981	1984	1985	1986
General CAP	3.0	3.6	6.0	5.1	7.3	6.8	na
CAP export subsidy	0.4	0.1	2.0	1.8	2.0	1.9	2.6
EC total	3.4	3.7	8.0	6.9	9.3	8.7	na
National subsidies	7.0	7.1	9.1	8.4	10.9	12.0	na
Total subsidies	10.4	10.8	17.1	15.3	20.2	20.7	na
Reporting agency							
Federal government	5.7	4.4	4.7	3.5	3.7	4.7	4.9
Kiel Institute[a]	7.0	7.1	9.1	8.4	10.9	na	na

[a] Preliminary.

Source: Derived from Jüttemeier 1987, and Federal Government Subsidy Reports ("Subventionsbericht"), various issues.

from Brazil or elsewhere. Beef prices in countries rich in natural resources, like Brazil, would increase so that consumers in those countries would reduce their consumption; but the country would still benefit from the positive terms of trade effect on income.

Estimates of price gaps and therefore of the nominal rate of protection diverge.[5] However, in most studies, estimated price gaps between the EC as a whole and world markets are in the range of 50 percent (see table 4.2). For this study we will use Anderson and Tyers' (1987) estimate for 1980–82 of 54 percent. In fact, the price difference in Germany appears to be higher than for other EC partners.[6]

Ambiguous Income Achievements

The goals laid down in Article 39 of the Treaty of Rome for the CAP are to (1) raise agricultural productivity, (2) ensure thereby a fair standard of living for the agricultural population, (3) stabilize markets, (4) guarantee regular food supplies to consumers, and (5) maintain reasonable consumer prices. The German 1955 Farm Law also aims at an increase of incomes by raising productivity. The ultimate objective is to secure and strengthen family farms.

Whether or not the income objective has been achieved depends on how income is defined. If one looks at the disposable income of farm households, regardless of the source, the policy results seem reasonable. As table 4.3 shows, the household income of farmers exceeds that of total private households and workers' households in 1974 and 1984. This gap has, however,

Table 4.2 Prices of Selected Agricultural Products in the EC and World Market (ECU/100kg)

Product	Year[a]	EEC entry price	Third country offer price[b]	Excess percentage of EC price over world price
Common wheat	1978–79	20.23	10.50	93
	1979–80	20.72	12.69	63
	1980–81	21.93	15.07	46
Durum wheat	1978–79	27.78	12.89	116
	1979–80	28.38	17.80	59
	1980–81	30.07	21.83	38
Husked rice	1978–79	37.35	23.75	57
	1979–80	39.15	29.88	31
	1980–81	41.67	41.51	00
Barley	1978–79	18.40	8.19	125
	1979–80	18.86	11.71	61
	1980–81	19.96	14.91	34
Maize	1978–79	18.40	9.14	101
	1979–80	18.86	9.92	90
	1980–81	19.96	13.55	47
White sugar	1978–79	42.62	15.46	176
	1979–80	43.26	32.32	34
	1980–81	45.55	53.58	– 15
Beef, veal (live weight)	1978–79	152.29	76.47	99
	1979–80	154.58	75.63	104
	1980–81	160.76	84.75	90
Pig meat (carcass weight)	1978	129.56	83.47	55
	1979	139.07	91.36	52
	1980	150.58	111.21	35
Butter	1978–79	309.17	76.71	303
	1979–80	309.90	75.39	311
	1980–81	319.59	111.73	186
Skimmed milk powder (spray)	1978–79	135.23	29.52	358
	1979–80	135.54	35.77	279
	1980–81	139.00	68.14	104
Olive oil	1978–79	231.56	115.72	100
	1979–80	235.04	125.78[c]	87
	1980–81	247.97	115.64[c]	114

Table 4.2 continued

Product	Year[a]	EEC entry price	Third country offer price[b]	Excess percentage of EC price over world price
Oil seeds	1978–79	38.96	24.18	61
	1979–80	39.55	21.39	85
	1980–81	42.28	25.20	68

[a] Marketing year varies according to product.

[b] Annual average third country offer price, usually lowest used for administration of agricultural markets.

[c] Ten-month average.

Source: derived from OECD (1987), table 13, 165.

narrowed because the income of nonfarmers has grown relatively faster between 1974 and 1984. However, this picture changes when one considers the source of income. In particular, 40 percent of the farms are operated on only a part-time basis and 52 percent of the farmers' gross income arises from nonfarming activities. When this factor is taken into account, farm households receive incomes out of agricultural activities about 20 percent less than workers' households. Moreover, an important component of agricultural income is subsidies. In this respect, agricultural protection has not been particularly successful in achieving its income objective.

The concept of disposable income used does not take into account changes of wealth. The value of wealth, particularly the value of land, rises when nominal income increases in the economy. Land as a nonreproducible resource has seen higher than average price increases for more than a century. The market price of agricultural land depends, inter alia, on agricultural commodity prices and on the price of land for nonagricultural uses. The price for agricultural land regardless of its size increased from DM 1.72 per square meter in 1975 to DM 3.92 in 1981, and thereafter declined to DM 3.68 (table 4.4). The purchase price for larger tracts of land was lower and increased more slowly. The latter price is used in order to calculate the value of farmland per average holding. Adding to this sum the market value of nonland assets and subtracting net debts, one obtains the wealth per farm household. Table 4.4 clearly shows that farm owners made reasonable profits in the past ten years. On average their wealth increased by DM 36,300 a year, equivalent to DM 8,403 per member of a farm household. In 1985 the mean value of wealth of the average farm household totaled DM 667,000 , that is

Table 4.3 Disposable Income (after taxes) of West German Households, 1974–1984 (deutsche marks)

	Households of					
Year	Farmers	Civilian employees	Clerks	Workers	Unemployed	Total private households
DM/household/year						
1974	30.431	32,891	29,913	23,046	16,544	25,557
1984	44,318	51,473	48,113	37,988	19,916	41,983
DM/Member of household/year						
1974	6,655	10,500	10,678	7,264	5,768	9,773
1984	10,264	17,142	18,179	12,472	8,028	17,361
Annual average increase (%) of income of household member						
1974–1984	5.4	6.3	7.0	7.1	3.9	7.7

Source: Own calculations derived from federal government statistics.

DM 154,398 per family member. However, herein lies a major distribution problem, for farm households cannot be equated with farm owners. There is a presumption that income disparities between rich and poor farmers in West Germany have increased over time.

Interest Groups

The major features of a protective system are usually deeply rooted in society and change little over time. In the late 1940s a new tariff schedule was established by a commission composed of thirteen members, five of whom could be viewed as directly proagriculture. Agriculture succeeded in getting high tariffs and, more importantly, in preserving a support system based on import controls and government marketing intervention. After Germany became a member of the GATT in 1951 trade was substantially and progressively liberalized; however, agriculture was exempted.

During this period interest groups became more and more organized, and Germany took on an increasingly corporative structure under the mantle of the social market economy. But this was only a return to normality, the connection with tradition being quite strong. One of these traditions was a "live and let live" strategy between interest groups: one does not attack the other unless the benefits from doing so are high. In this vein, the key institutional change initiated by the Farmers Federation was the Farm Law of 1955. This committed the government to using trade, tax, credit, and price policy

Table 4.4 Land Prices and Market Values of Farmland and of Average Farm (selected years)

	1975	1981	1985	Difference between 1985 and 1975	Difference between 1985 and 1981
Land prices of properties (DM per m^2)[a]	35.09	72.66	78.69	43.60	6.03
Prices of farmland					
Average purchase price	1.72	3.92	3.68	+1.96	−0.24
Purchase price of land larger than 5 ha[c]	1.41	3.66	3.11	+1.70	−0.55
Farm rent (DM per 10,000 m^2)	237.00	331.00	395.00	+158.00	+64.00
Farmland per farm in 10,000 m^2	13.98	15.52	16.83	+2.85	1.31
Value of farmland[b] per farm owner in DM 1,000	194	568	523	+326	−45
Total wealth minus net debts per farm in DM 1,000	304	702	667	+363	−35

[a] m^2 = square meter.
[b] Farmland was valued with the lower purchase price.
[c] ha = hectare, equivalent to 2.76 acres or 10,000 m^2.
Source: Own calculations derived from federal government statistics.

in order both to counter the "natural and economic disadvantages" which agriculture supposedly suffered relative to other sectors, and to increase productivity. Moreover, young farmers were to be assisted by a lump sum when they started working (currently DM 10,000). Interestingly enough, the Farmers Federation cleared the legislation in good time with both the Federation of German Industry and the German Federation of Trade Unions. Since then the German farming lobbyists have maintained their position fundamentally unaltered—in spite of the slow rise of food consumption, the buoyant production surpluses, the grave budgetary burden, and farmers' increasing dissatisfaction with their income levels. In order to secure public support, the Farmers Federation continues to insist on the intrinsic societal value of agriculture, now as a protector of the environment and as a source of food aid to developing countries.

The CAP is said to be the concession which West Germany had to make in order to reach an agreement on a common market for manufactured goods. Indeed, during the founding negotiations, France insisted that agriculture be included in a customs union. The institutional framework of a common agricultural market had not then been decided. The EC treaty offered three options: (1) common competition rules, (2) binding coordination of the different national market organizations, and (3) a single European market organization. From an economic point of view, a single European market organization is inferior to option 1 because it must set prices. The French and German farmers' associations and the parliaments had been in favor of guaranteeing stable prices within the common market organization. It was therefore decided at the meeting of agricultural ministers in Stresa (in 1958) that a single European market organization for the main temperate zone commodities should be created. In 1962 German and French delegates in the Council of Ministers were at odds about the level at which the common prices should be set. France, having an advantage in agriculture compared to Germany, argued for low support prices, especially for grain where France was a net exporter. As can be seen from table 4.5, French prices were below German prices before the unified market organizations were decided in 1962. The common prices of 1968 were then set at a level near or above German prices.

Since then the EC Commission has periodically made attempts to reduce agricultural support prices, but these have mostly been overruled by the Council of Agricultural Ministers. In most farm price negotiations, the German minister, in accordance with the Farmers Federation, has argued for prices higher than the commission wished (Dicke et al. 1987). In the 1985 round, the German minister of agriculture even vetoed the EC Council's decision for a small reduction in grain prices.

Medium-Run Effects of Agricultural Trade Liberalization

In order to assess the economywide effects of current agricultural policy we examine the obverse: a liberalization of the policy. As with most policy changes, the response depends on the time perspective. In this section we focus on the medium run, which is defined as the period required for mobility of labor and capital between sectors. For the investigation, we use the Kiel Institute's general equilibrium model of Germany.[7]

Table 4.5 CAP Prices and Producer Prices in Germany and France, 1960–61, 1983, 1984 (DM/100 kg)

	German producer price		French producer price		CAP price	
	1960–61	1983	1960–61	1983	1968–69	1984
Wheat	40.8	49.59	32.34	38.90	43.7[b]	57.99[b]
Sugar beets	7.11	12.80	5.60	6.43	7.00[c]	9.15[c]
Cattle, beef	214.20	329.00	191.50	312.37	279.86[d]	458.86[d]
Pigs, slaughtered	257.40[a]	353.00	221.30[a]	358.75	308.67[d]	455.07[d]
Cow milk	36.80[e]	62.71	31.00	51.00	42.39	61.39

[a] 1960–61 prices for living pigs.
[b] Target price.
[c] Minimum purchase price of the factory.
[d] Guide price.
[e] Including production subsidies.
Source: Own calculations derived from Krohn and Schmitt (1962) and data from the Statistical Office of the EC and Federal Ministry of Agriculture.

The General Equilibrium Approach

In modeling the effects of agricultural liberalization it is important to place the sector correctly—not within the context of a free trade system but in a trade regime with protection and distortions. In West Germany, as in other industrial countries, nontariff barriers (NTBs) (ranging from "voluntary" export restraint arrangements, through import quotas, to subsidies) have become a major tool of the government for intervening in product markets in order to attain specific growth, income, and employment goals (Donges and Schatz 1986). Nowadays, NTBs on selected manufactures are as widespread as those on agricultural products. Within the manufacturing industry, the nature and extent of incidence varies widely with a clear trend towards selectivity (Klepper, Weiss, and Witteler 1987).

We have accordingly specified a model with thirteen sectors; their salient features with regard to the government support they enjoy are documented in table 4.6. Apart from agricultural and food-processing sectors, we incorporate seven manufacturing and three service sectors. In terms of total protection, the "gang of four" are thus explicitly represented: agriculture, coal mining, iron and steel, and clothing and textiles. We have therefore included not only high- and low-protected sectors but also a variation in the nature of

Table 4.6 General Features of the Protection System, 1980 (percent)

Production sector	Nominal tariff	Effective protection: Implicit	Effective protection: Rate of subsidy	Effective protection: Total protection
1 Agriculture, forestry, and fishing	11.5[a]	na	na	na
2 Food processing and beverages	11.8[a]	na	na	na
3 Coal mining	0.0	189.2	147.6	336.8
4 Iron and steel	7.0	20.0	7.0	22.0
5 Basic commodities	5.0	14.0	2.0	15.0
6 Aerospace	7.0	15.8	29.6	45.4
7 Electrical engineering, data processing	6.0	8.0	4.0	10.0
8 Mechanical engineering	7.0	2.0	2.0	4.0
9 Clothing and textiles	13.0	95.0	2.5	97.0
10 Other consumer goods	8.0	13.0	2.0	14.0
11 Construction and housing	0.0	na	11.1	na
12 Market services	0.0	na	8.1	na
13 Nonmarket services	0.0	na	na	na

[a] The nominal tariffs have been derived from the national accounts data on customs income and are therefore biased in the well-known manner. They should not be confused with the true nominal protection derived directly from price comparisons.

Source: With the exception of sectors 1, 2, 11, 12, derived from Witteler 1986.

protection; for example, agriculture relies to a great extent on subsidies whereas clothing and textiles are protected in ways which do not directly involve budget transfers (through the Multi-Fibre Arrangement).

The model is calibrated for 1980. The allocation of subsidies by sector and use, including also CAP production and export subsidies, is shown in table 4.7. It is clear that not only is the allocation of subsidies across sectors uneven, but that the use of the subsidy also differs. Whereas in agriculture the bulk of the subsidy is production oriented, in other sectors it relates primarily to investment. The intraindustry allocation of subsidies is thus explicitly taken into account by our model.

We do not further disaggregate the agricultural sector, at least not at this stage. This has a drawback in that competing and noncompeting agricultural imports are not explicitly recognized. The fact that a great deal of agricultural imports are of the noncompeting variety (i.e., tropical products) is, however, implicitly represented by a low elasticity of substitution between domestic and foreign goods.

In its present form the model considers only Germany: EC linkages are

Table 4.7 Allocation of Subsidies by Sector and Use, 1980

Producer sector	German IO categories	Allocation of subsidy (percent) by division				
		Sector	Use[a]			
1 Agriculture, forestry, and fishing	1, 2	16.66	1	48.7	4	34.6
			2	7.7	5	6.0
			3	3.0		
2 Food processing and beverages	38–40	0.87	1	50.3	4	0.4
			2	1.6	5	40.5
			3	7.2		
3 Coal mining	6	5.86	1	38.0	4	4.7
			2	18.7	5	16.7
			3	21.9		
4 Iron and steel	16, 18, 19	0.44	1	7.4	4	0.0
			2	18.4	5	61.5
			3	12.7		
5 Basic commodities	4, 5, 7–10, 12, 13, 17, 30, 32	1.66	1	7.4	4	0.0
			2	15.7	5	62.5
			3	9.8		
6 Aerospace	25	0.76	1	6.0	4	0.0
			2	42.5	5	21.1
			3	30.3		
7 Electrical engineering, data processing	22, 26	1.65	1	27.7	4	0.1
			2	20.3	5	22.4
			3	29.5		
8 Mechanical engineering		2.54	1	22.6	4	1.8
			2	13.3	5	44.7
			3	17.6		
9 Textiles and clothing	36, 37	0.22	1	34.8	4	0.0
			2	3.9	5	46.0
			3	13.7		
10 Other consumer goods	11, 14, 15, 27, 29, 31, 33–35	1.13	1	34.8	4	0.0
			2	3.8	5	49.3
			3	12.0		
11 Housing and construction	41, 42, 51	17.13	1	12.2	4	20.3
			2	1.2	5	65.1
			3	1.2		
12 Market services	43–50, 52–55, 3	32.76	1	23.6	4	20.7
			2	15.4	5	19.7
			3	20.6		

Table 4.7 continued

Producer sector	German IO categories	Allocation of subsidy (percent) by division				
		Sector	Use[a]			
13 Nonmarket services	56–58	18.32	1	3.4	4	34.8
			2	14.0	5	14.6
			3	33.2		

[a] 1 = production, 2 = intermediate inputs, 3 = wages, 4 = property income, 5 = capital formation.
Source: Derived from Jüttemeier (1987).

not explicitly recognized. This is an important omission since the customs union provides important protection for German industry which is not thereby represented. We do assume, however, that Germany is not a small country, the export demand for all trading sectors being governed by finite export demand elasticities. Import demands, by contrast, do not affect world prices.

Domestic commodities are produced by four types of primary factors (unskilled labor, skilled labor, reproducible capital, and a sector-specific factor called land) and by domestic and foreign intermediates. A differentiation of labor by skills is important given comparative advantage considerations and the observation that unemployment in Germany (as in other West European countries) is primarily concentrated in unskilled (or wrongly skilled) groups (Donges et al. 1988). All primary factors except land are considered mobile among sectors in the medium run. Labor, however, is not mobile among skill groups. The capital market is believed to be fully integrated both domestically and internationally: any differences of return to capital after taxes in the long run are assumed to reflect considerations which are not affected by agricultural protection. Note that capital costs to producers can differ widely because of taxes and subsidies which are incorporated in the model.

The government budget equation recognizes direct and indirect taxes and subsidies which, as noted above, include all CAP payments. In this model the government budget is balanced, the endogenous policy instrument in all reported simulations being the direct tax rate. Direct taxes will therefore decline as an immediate consequence of budget savings. It should be noted that we have in effect aggregated the Commission's budget restriction with the domestic budget.

Given the endogenous nature of the direct tax rate, it is important to specify its impact in a little more detail. Investment is assumed to be influenced by after tax rates of return; but more significant is our assumption about wages and the labor market. For all simulations we assume that real consumer wages after tax remain constant so that a decline in the direct tax rate would lower nominal wages. At this real wage, employment is determined by the demand for labor, there being either an unspecified pool of unemployed or an infinitely elastic labor supply function. This wage assumption rests on the idea that trade unions may not be prepared to accept cuts in real net wages, but they may permit the efficiency gains arising from liberalization to accrue to the business sector, also by way of tax reductions, in order to improve employment opportunities.

In our representation of agricultural trade liberalization, the mechanisms of CAP protection—variable levies, monetary compensatory amounts, stockpiling, and so forth—are not explicitly represented; instead, we are concerned with the removal of equivalents. A change in the intervention price is therefore simulated by reducing the implicit protection rate in agriculture from 54 percent to zero. With respect to subsidies, one must be careful to avoid double counting and to consider only "coupled" programs. Consequently, the export subsidies (see table 4.1) are treated explicitly and are not viewed as a production subsidy (table 4.7). Similarly, the income subsidy, defined as category 4, table 4.7, mainly refers to social security provisions and is therefore treated as "uncoupled." It will, of course, be a retarding factor in the migration of labor out of agriculture and in the determination of land prices. The liberalization experiment therefore involves the removal of all production, input, and investment subsidies which, together with the change in the implicit tariff, corresponds to the concept of producer subsidy equivalent and consumer subsidy equivalent (see OECD 1987).[8] For the food-processing sector the subsidy programs are quite specific (e.g., Berlin promotion) and are not taken into account. Liberalization in this case involves removal of an implicit protection rate of 11.8 percent (table 4.6).

Agricultural trade liberalization will, of course, also have general equilibrium effects on the world prices of agricultural commodities, industrial goods, and traded services. These changes will depend on whether one is considering a world liberalization or only liberalization on the part of the EC. Given this uncertainty, we have arbitrarily incorporated an increase in the world price of agricultural goods of 10 percent.

One of the most controversial aspects of applied general equilibrium modeling is the macroeconomic content. Results will depend on the closure chosen. In our case there are two aspects. First, we have assumed a constant after tax consumer real wage, thereby implying that a change in the level of employment is determined by a change in labor demand. A Walrasian closure along the lines of trade theoretic models would hold the level of employment constant and allow wages to change. We have chosen our closure since there is a lot of evidence to suggest wage rigidity (both level and structure) and because current policy concerns are strongly oriented toward employment. Second, one must specify the operation of the savings/investment identity. We assume a prespecified balance on current account together with a balanced government budget. With respect to the latter, government expenditure is assumed to be targeted on the nominal level, which is held constant. The ratio between aggregate real investment and aggregate real consumption is held constant.

Macroeconomic Consequences

The results are presented in table 4.8, where the nominal exchange rate is taken to be the numeraire. The most striking finding is the significant increase in the volume of employment if protective measures are removed: the level of unskilled employment increases by 3.8 percent, that of skilled employment by 4 percent.[9] Put another way, under agricultural protection, and within a distorted system, unskilled employment is the relatively protected factor but at the price of an overall lower level of employment. Similarly, agricultural protection (liberalization) decreases (increases) GNP by 3.3 percent and real income by 2.5 percent. The difference is due to induced terms of trade effects (see table 4.10).

With respect to foreign trade, agricultural protection is clearly trade contractionary. Under liberalization, the trade volume increases by 5.1 percent and the real exchange rate (defined in terms of the consumer price index) consequently depreciates by 1.8 percent. As is clear from table 4.9, the relatively small change in the consumer price index is due to conflicting influences. On the one hand reduction of the target price reduces agricultural import prices by 44 percent, but the simultaneous removal of the production subsidies increases the prices of domestically produced goods.

Examining the public finance aspects of table 4.8, it is apparent that partial analysis overstates the budget savings arising from liberalization. Thus table 4.7 implies a change in subsidies of around 11 percent (in 1980 prices this amounts to DM 12.1 billion), yet table 4.8 indicates a saving of 9.5 percent. The explanation is that other subsidized sectors expand following liberalization (see following section). The restricted budgetary savings also imply that

Table 4.8 Summary of Macroeconomic Simulation Results: Agricultural Liberalization and Full Trade Liberalization (percentage change in variable)

Variable	Agricultural liberalization	Full liberalization
Macroeconomic		
GNP	3.3	9.1
Real income	2.5	6.9
Real consumption	2.7	7.8
Aggregate imports and exports	5.1	25.9
Real exchange rate[a]	−1.8	−4.2
Unskilled employment	3.8	11.2
Skilled employment	4.0	12.1
Real wages after tax	0.0	0.0
Real wages before tax[a]	−0.1	−8.8
Consumer price index	−1.8	−4.2
Government finance		
Average direct tax rate	−0.2	−20.2
Direct tax revenue	1.4	−23.6
Revenue from direct and indirect taxes	−2.4	−25.9
Subsidies excluding exports	−9.5	−102.00
Government expenditure	0.0	0.0
Real government expenditure	1.7	4.1

[a] Defined with respect to the consumer price index.

the direct tax rate does not decrease to the extent that partial analysis would suggest. In the present simulation real government expenditures increase by 1.7 percent. In simulations not reported here we held the real expenditure level constant. Employment increases by around 1.8 percent, establishing a lower limit for our estimates.

As stressed above, agriculture is highly protected but so are several other sectors. In table 4.8 we therefore also report the effects of a full liberalization: the elimination of all implicit tariffs and subsidies (see Kirkpatrick 1988 for a full description). Taking this as a reference case, agricultural protection accounts for about a third of the substantial costs associated with the present trade regime. It will be noted that both simulations imply substantial increases in the level of skilled employment (in a Walrasian closure this would be reflected in a substantial increase in the relative wage of skilled labor). The certainty that this supply would in fact be forthcoming or that relative wage changes would reduce the demand for skilled labor raises the question of appropriate internal liberalization measures to accompany external liberalization. We will return to this point below.

Table 4.9 Sector and Commodity Simulation Results of Agricultural Trade Liberalization (percentage change in variable)

Production Sector	Output: Agricultural liberalization	Output: Full liberalization	Labor demand[a]	Producer price	Consumer demand	Price of land
1 Agriculture	−24.7	−26.5	−23.8	15.5[b]	3.8	−17.2
2 Food processing	−10.3	−8.5	−10.3	−1.1	2.0	—
3 Coal mining	5.4	−63.7	5.5	−1.5	1.5	3.6
4 Iron and steel	7.8	7.6	7.9	−1.4	2.1	—
5 Basic commodities	5.7	16.2	5.9	−1.1	2.1	—
6 Aerospace	7.5	−23.1	7.6	−1.3	0.0	—
7 Electrical engineering	9.0	33.1	9.2	−1.4	1.2	—
8 Mechanical engineering	5.3	19.0	5.4	−1.5	1.3	—
9 Clothing and textiles	15.1	−23.4	15.3	−3.3	2.2	—
10 Other consumer goods	4.2	9.5	4.4	−1.4	1.3	—
11 Construction and housing	2.8	11.6	3.2	−1.3	2.6	—
12 Market services	3.4	8.8	3.7	−1.6	3.8	—
13 Nonmarket services	1.8	4.4	1.8	−1.8	1.7	—

[a] As relative wages are held constant, skilled and unskilled sectoral employment alter in the same proportion to overall sectoral employment.

[b] The leftward movement of both the demand and supply curves can lead to an increase in the relative price of the domestic good. This result is, however, very sensitive to the chosen parameters. In all likelihood the price will fall.

Structural and Trade Effects

The sectoral effects of agricultural liberalization are documented in table 4.9. As to be expected, output in agriculture and food processing decreases by 24.7 and 10.3 percent, respectively. This is mirrored by a similar fall in sectoral employment, and a decrease in land rentals (the factor specific to the agriculture sector) of 17.2 percent. Both these factors are crucial in describing the political economy of protection. This is particularly so if labor and capital in agriculture are viewed as also being sector-specific: the removal of agricultural protection would substantially reduce returns to these factors —hence farmers' opposition to a radical reform of existing price and market policies.

Output and employment in all other sectors would increase, particularly in the two important engineering sectors. In other words, agricultural protection taxes these industries through general equilibrium processes such as wage, tax, and exchange rate behavior. Rather surprisingly, output in three protected sectors (coal mining, iron and steel, clothing and textiles) grows following partial liberalization. As partial liberalization within a distorted system can lead to unpleasant surprises (theory of second best), we also present in table 4.9 the changes in sectoral output arising from a full liberalization (see Kirkpatrick 1988). Particularly noticeable are the coal mining and clothing and textiles sectors where partial liberalization results in output increases, yet full liberalization leads exactly to the reverse. With the minor exception of aerospace, all other sectors move in the correct general direction. This suggests that the best package of liberalization is one which does not focus attention solely on agriculture but on the sectors with the highest protection. In terms of international trade negotiations and the current Uruguay Round, our analysis suggests a Tokyo Round approach, i.e., across-the-board cuts of protective measures with greater reductions in the more highly protected sectors—agriculture and clothing and textiles.

Also of interest from table 4.9 is the implication that iron and steel, one of the protected sectors, is in fact taxed by agricultural protection. The supporting measures for this industry are primarily offsets for distortions elsewhere in the economy. Whether the nature of the game is such that these production increases would be accepted by other countries is a question not dealt with by our present model.

Reflecting the structural shift in production are important changes in the commodity composition of trade, presented in table 4.10. As expected, agricultural exports decline and imports substantially increase. Food-processing imports increase by around 72 percent. Matching the increase in agricultural and food-processing imports is a decline in the imports of all other commodities, in particular clothing and textiles (−15.3 percent). With full liberalization this result is, of course, reversed; clothing and textiles and coal imports substantially increase. On the other hand, basic commodities (this includes chemicals) and electrical and mechanical engineering all increase their net export positions. These results are consistent with the fact that these industries have a comparative advantage in Germany (Donges et al. 1988). The simulation results therefore generally support the claim that agricultural protection taxes the classic export industries, reducing their net exports, production, and employment.[10]

Conclusions

The objective of the present study has been the enhancement of agricultural policy reform by improving transparency of the real economywide costs of

Table 4.10 Sectoral Development of Foreign Trade Following an Agricultural Trade Liberalization (percentage change in variable)

	1980 share of		Volume of		Price of	
Production sector	Imports	Exports	Imports	Exports	Imports[a]	Exports[b]
1 Agriculture	7.7	0.7	33.9	−31.0	−44.0	15.5
2 Food processing	5.8	4.0	71.9	2.3	−11.8	−1.1
3 Coal mining	0.4	1.0	−9.6	2.9	0.0	−1.5
4 Iron and steel	3.9	6.1	−3.5	9.2	0.0	−1.5
5 Basic commodities	39.7	18.9	−0.4	5.4	0.0	−1.1
6 Aerospace	1.0	0.5	0.7	6.6	0.0	−1.3
7 Electrical engineering	6.9	9.5	−1.8	14.4	0.0	−1.4
8 Mechanical engineering	10.6	32.0	−4.7	7.3	0.0	−1.5
9 Clothing and textiles	6.9	3.4	−15.3	6.6	0.0	−3.3
10 Other consumer goods	7.5	7.0	−6.4	2.8	0.0	−1.4
11 Construction and housing	1.6	2.3	0.4	1.3	0.0	−1.3
12 Market services	8.0	14.3	0.5	3.2	0.0	−1.6
13 Nonmarket services	—	—	—	—	—	—

[a] Import price in domestic currency including tariffs. Foreign prices are fixed.

[b] Foreign currency export price including the effect of any export subsidies.

current agricultural policies and the gains that would be possible from liberalization. We have therefore focused on broad aggregates, neglecting the detailed commodity composition of agriculture, which is normally of central interest in public debate.

The approach which we have followed shows that quantifying the budgetary costs, or undertaking a consumer surplus analysis, does not capture fully the economywide costs of the German government support programs for the agricultural sector. Our use of the term "cost" is more differentiated. With this in mind, the primary cost associated with agricultural protection (under conditions of real wage rigidity) is a decrease in the level of overall employment on the order of 200,000 to 400,000 workers, and a loss in income of about 3 percent: expansion of employment in the two agricultural sectors has been bought at the cost of lower overall employment. Seen on a sectoral level, agricultural protection lowers employment and output in practically all other sectors, particularly those, such as electrical and mechanical engineering, in which West Germany is perceived to have a comparative advantage. Classic export industries are therefore taxed by agricultural protection. Under the contrary policy—agricultural trade liberalization—there is the prospect for society to achieve higher employment and income levels. This general benefit is the obverse of the reported economywide costs of agricultural protection. Our analysis has also shown that taking a liberalization strategy beyond agriculture to encompass the whole economy would result in even more significant net output and employment effects.

It was therefore a timely decision to put agricultural trade liberalization on the agenda for the Uruguay Round, which started early in 1987 under the auspices of the GATT. However, there is no need for the German federal government and the other member governments of the EC to wait for the completion of the Uruguay Round before embarking on a market-oriented reform of the CAP; as demonstrated here, such reform would be in their own best interest.

So far, policy decisions have gone in the wrong direction—treating the symptoms rather than the disease[11]—and, furthermore, are not satisfying the farmers (who believe that they are harmed by these policies). In a liberalization strategy the farmers would also lose, mainly because the reduction of agricultural prices would depress land rentals and the value of other sector-specific assets such as buildings and livestock. This may be the root cause of the resistance within the farming community to the overdue reform. It may therefore be necessary to consider whether this resistance could be overcome by a scheme which compensates farmers for these wealth losses. As first suggested by Professor Giersch, this could be undertaken by an issue of government bonds to be allocated among farmers, who could then use the interest income or proceeds from the sale of their bonds for whatever purpose they considered profitable: in agriculture (but then at world market prices), in forestry, in industry, or in services in either rural or nonrural areas. The details of such a scheme are currently under investigation.

Notes

1. See Gerken et al. (1985) and Jüttemeier (1987).
2. Since 1984 the value-added tax actually has been negative.
3. Germany's contribution to the EC agricultural budget amounted to about 28 percent of DM 13.2 billion in 1985.
4. Related to the number of farm owners, the financial cost in 1985 was DM 26,460.
5. For a discussion of the measurement problems see for example OECD (1987) and U.S. Department of Agriculture (1987).
6. See World Bank, *World Development Report 1986,* 23. In a world comparison, countries with higher nominal protection rates include Sweden, Italy, and Japan. EC partners the United Kingdom and France have lower rates.

7. The model is derived from the ORANI work of Dixon et al. (1982) and an earlier version is documented in Gerken and Gross (1985). Previous applications include studies on steel subsidies (Gerken, Gross, and Laechler 1986), subsidy reductions (Gerken et al. 1985), and trade liberalization (Kirkpatrick 1988), as well as studies on the impact of alternative subsidies-cum-import protection packages (Donges and Glissmann 1987; Donges et al. 1988). The model is currently being once more refined and extended (Kirkpatrick 1987).

8. These are concepts to measure the subsidy needed to compensate producers (consumers) for the income loss (price increase) likely to occur if all farm support programs were eliminated.

9. The results generally support the findings by Stoeckel (1985) for the EC as a whole—that the CAP has caused a substantial loss of jobs.

10. See Clements and Sjaastad (1984) for a discussion of the mechanism by which the cost of sectoral protection is passed on to other (the less protected) activities.

11. This assessment need not be modified in the light of the agreements reached at the special summit in February 1988, which took place after this study had been written. On the contrary, the idea has been reinforced that budgetary outlays are the only costs and that the German "national" interest is served by agricultural protection.

References

Anderson, K., and R. Tyers. 1987. *Liberalizing OECD agricultural policies in the Uruguay Round: Effects on trade and welfare.* Australian National University, Working Papers in Trade and Development no. 87/10. Canberra.

Bundesverband der Deutschen Industrie. 1987. *Agrarpolitik—Denkanstösse für eine marktwirtschaftliche Reform.* Cologne: BDI.

Clements, K. W., and L. A. Sjaastad. 1984. *How protection taxes exporters.* Thames Essay no. 39. London: Trade Policy Research Centre.

Dicke, H., A. Bothe, H. Böhme, E.-J. Horn, H. Lehment, E. Kanthack, H. Sichelschmidt, and J. Zietz. 1987. *EG-Politik auf dem Prüfstand—Wirkungen auf Wachstum und Strukturwandel in der Bundesrepublik.* Tübingen: J.C.B. Mohr (for the Kiel Institute of World Economics).

Dixon, P. B., B. R. Parmenter, J. Sutton, and D. P. Vincent. 1982. *ORANI: A multisectoral model of the Australian economy.* Amsterdam: North-Holland Publishing Co.

Donges, J. B., and H. Glissmann. 1987. *Industrial adjustment in Western Europe: Retrospect and prospect.* Kiel Working Papers no. 280. Kiel.

Donges, J. B., and K. W. Schatz. 1986. *Staatliche Interventionen in der Bundesrepublik Deutschland: Umfang, Struktur, Wirkungen.* Kiel Discussion Papers nos. 119, 120. Kiel.

Donges, J. B., K.-D. Schmidt, H. Dicke, E. Gundlach, K. H. Jüttemeier, H. Klodt, and F. D. Weiss. 1988. *Mehr Strukturwandel für Wachstum und Beschäftigung—Die deutsche Wirtschaft im Anpassungsstau.* Tübingen: J.C.B. Mohr (for the Kiel Institute of World Economics).

Gerken, E., and M. Gross. 1985. *A structural policy model for the Federal Republic of Germany.* Kiel Working Papers no. 240. Kiel.

Gerken, E., M. Gross, and U. Laechler. 1986. The causes and consequences of steel subsidization in Germany. *European Economic Review* 30: 773–804.

Gerken, E., K. H. Jüttemeier, K.-W. Schatz, and K.-D. Schmidt. 1985. *Mehr Arbeitsplätze durch Subventionsabbau.* Kiel Discussion Papers nos. 113, 114. Kiel.

Jüttemeier, K. 1987. *Subsidizing the federal German economy: Figures and facts, 1973–1984.* Kiel Working Papers no. 279. Kiel.

Kirkpatrick, G. 1987. *The Kiel general equilibrium model of Germany: Update and current and planned developments.* Kiel: Kiel Institute of World Economics.

———. 1988. Simulating liberalization—A general equilibrium approach. In F. D. Weiss et al., *Trade Policy in West Germany.* Tübingen: J.C.B. Mohr (for the Kiel Institute of World Economics).

Klepper, G., F. D. Weiss, and D. Witteler. 1987. Protection in Germany: Toward industrial selectivity. In *Free trade in the World Economy: Towards an opening of markets,* ed. H. Giersch, 171–91. Tübingen: J.C.B. Mohr.

Kravis, I. B., A. Heston, and R. Summers. 1982. *World product and income.* Baltimore, London: Johns Hopkins Univ. Press.

Krohn, H. B., and G. Schmitt. 1962. Agrarpolitik für Europa. *Agrarwirtschaft,* special issue no. 15.

OECD. 1987. *National policies and agricultural trade.* Paris.

Stoeckel, A. 1985. *Intersectoral effects of the CAP: Growth, trade and unemployment.* Bureau of Agricultural Economics Occasional Paper no. 95. Canberra.

U.S. Department of Agriculture. 1987. *Government intervention in agriculture: Measurement, evaluation, and implications for trade negotiations.* FAER no. 229. Washington, D.C.

World Bank. 1986. *World development report 1986.* New York: Oxford Univ. Press.

5. Domestic Effects of Agricultural Protection in Asian Countries with Special Reference to Korea

David Vincent

Summary

Government protection of domestic agriculture is widespread in the Asian region. Rates of protection, as measured by conventional domestic-to-border price ratios for agricultural products, have grown at a rapid rate for the East Asian economies of Japan, Korea, and Taiwan, reaching levels which are now commensurate with, or exceed, those of the European Community.

This rapid growth of agricultural protection reflects the attempts by respective governments to cushion (and in the case of Korea, eliminate) the adverse adjustment pressures imposed on domestic agriculture by the spectacular rates of export-led manufacturing growth achieved by these countries. The policy response of increased agricultural protection has had inevitable consequences in turn for the growth prospects of both agricultural and nonagricultural activities and for overall economic performance in these countries. Results from a computable general equilibrium model analysis of the effects of agricultural protection in one such country, Korea, suggest the following.

Agricultural protection in Korea has substantially reduced the volume of competing agricultural imports into that country. In the absence of such protection agricultural import volumes would more than double.

This in turn has allowed domestic agricultural producers to raise selling prices and greatly expand their output (by up to 20 percent) and employment (by up to 60 percent) measured against the situation which would have existed in the absence of agricultural protection.

As a result, farm incomes in Korea have been raised significantly—more than 40 percent in real terms for producers of cereals, about 20 percent for producers of other crops, and about 12 percent for producers of livestock—principally through an escalation in the returns earned by agricultural land. The price of agricultural cropland has been inflated by about 44 percent in the case of cereals and 28 percent in the case of other crops.

Thus, ignoring its wider effects, the policy of agricultural protection in Korea has gone a long way toward meeting its narrowly specified objectives. However, these gains to agriculture have been achieved at considerable cost to other sectors of Korean economic activity.

Measured against an economy characterized by an inflexible labor market with respect to nominal wages, these costs are in the form of a substantial reduction in real wages and in the international competitiveness of Korean export activities, and, to a lesser extent, in sectors outside agriculture competing for domestic market share against imports. As a result export, output, employment, and incomes in these sectors have been heavily curtailed relative to the situation of no agricultural protection. As an example, the model projects that if agricultural protection were removed, then, as a consequence of the deflationary effect on domestic prices, particularly food prices, real wages CPI-deflated would increase by about 6 percent (around 277,000 won) in 1987. Aggregate export earnings would increase by nearly 9 percent, equivalent to about 3,329 billion won in 1987. Assuming that the labor market gains were taken in the form of increased aggregate employment at a constant real wage, then the results indicate that the removal of agricultural protection would provide a boost of more than 8 percent to total employment.

Measured against an economy characterized by flexible adjustment of the labor market, these costs are in the form of reduced exports, output, and employment in Korean manufacturing and a sizable reduction in the economy-wide wage level, total labor income, and the share of the national income going to labor. For example, the results suggest that the removal of agricultural protection would lead to a boost to aggregate exports of about 4,484 billion won, increased employment in various processing and manufacturing activities of about 580,000 jobs, and an increase in the average wage level of about 250,000 won per worker in 1987. Clear winners from agricultural protection in Korea are the owners of agricultural land.

Increasing numbers of Asian economies are moving along the path of economic development experienced initially by Japan and subsequently by Korea and Taiwan. This path is characterized by rapidly rising national incomes generated by export-led manufacturing growth, with the resultant adjustment pressures on agriculture being offset by escalating domestic agricultural protection. This suggests that the conclusions drawn from the Korean case study are likely to be more widely applicable throughout Asia in the near future.

Introduction

This chapter addresses the issue of agricultural protection in the Asian region, its evolution, present level, and effects. Countries within the Asian region exhibit considerable differences in government policies towards agriculture. In part this reflects the diversity among such countries with regard to agricultural land endowment, stage of economic development, growth strategy being pursued, and sectoral composition of economic activity and employment. In considering the effects of agricultural protection in Asian countries it is difficult, therefore, to make broad generalizations. Rather, a case study approach which takes into account the salient features of individual countries or country categories that comprise the Asian region is needed.

The discussion is structured as follows. The next section compares the recent economic performance of selected Asian economies and the present structure and relative importance of the agricultural sector in each country. An understanding of the development process in each country and the implications for the agricultural sector is a necessary precursor to interpreting current patterns of agricultural protection in Asia. This forms the subject of the third section. This analysis clearly identifies the East Asian countries of Japan, the Republic of Korea (hereafter Korea), and Taiwan as being those in which agricultural protection is currently highest and likely to be imposing significant costs on the performance of other sectors and on the economy as a whole. In the final section a computable general equilibrium model of the Korean economy is used to study in some detail the effects of Korean agricultural protection on domestic economic performance.

Agriculture in Asian Economies

Table 5.1 provides some summary information on economic performance, the commodity composition of agricultural production, and the importance of agriculture in the economy for a selection of Asian countries. These statis-

Table 5.1 Importance of Agriculture in Selected Asian Economies

	North Asia	East Asia			ASEAN			West Asia		
	China	Japan	Korea	Taiwan	Indonesia	Philippines	Thailand	India	Pakistan	Bangladesh
Commodity composition of food production[a]										
Rice	0.27	0.22	0.57	0.32	0.66	0.31	0.51	0.35	0.09	0.76
Wheat	0.29	0.02	0.00	0.00	0.00	0.00	0.00	0.17	0.32	0.05
Coarse grain	0.14	0.01	0.02	0.01	0.08	0.11	0.10	0.09	0.02	0.00
Sugar	0.01	0.01	0.00	0.03	0.08	0.10	0.09	0.03	0.02	0.00
Dairy	0.03	0.26	0.10	0.00	0.01	0.01	0.00	0.31	0.23	0.08
Ruminant meat	0.03	0.21	0.12	0.01	0.09	0.14	0.11	0.04	0.30	0.08
Nonruminant meat	0.23	0.29	0.19	0.63	0.08	0.39	0.19	0.01	0.02	0.03
Share of agriculture in GDP[b]	0.33	0.03	0.14	0.06	0.24	0.27	0.17	0.31	0.25	0.50
Share of agricultural employment in total employment[b]	0.74	0.11	0.36	0.27	0.57	0.52	0.71	0.70	0.55	0.75
Recent economic performance[c]										
Annual growth rate of economy (percent)										
1960–1980	6.4	6.3	9.5		7.9	5.9	7.4	3.8	5.2	2.4
1980–1985	9.8	3.8	7.9		3.5	−0.5	5.1	5.2	6.0	3.6
Annual growth rate of agriculture (percent)										
1960–1980	3.0	0.8	3.0		4.3	4.6	4.9	2.8	3.3	1.5
1980–1985	9.4	1.6	6.3		3.1	1.7	3.4	2.7	2.1	2.8

[a] Figures represent shares computed from producer value of production and refer to 1985–86.
[b] Figures for countries except Taiwan refer to 1985 and were obtained from the World Bank (1987). Figures for Taiwan refer to 1980 and were obtained from Anderson and Hayami (1986).
[c] Obtained from the World Bank (1987).
Sources: Food and Agriculture Organization, *Production Yearbook* (Rome: FAO, 1987), and Taiwan Department of Agriculture and Forestry, *Taiwan Agricultural Yearbook* (Taipei: Taiwan Department of Agriculture, 1987).

tics are a useful aid to interpreting the different intensities of domestic agricultural protection which have emerged throughout the Asian region.

The table considers countries from North Asia (China), East Asia (Japan, Korea, Taiwan), three members of the ASEAN group (Indonesia, Philippines, Thailand), and countries of the Indian subcontinent (India, Pakistan, Bangladesh). While this coverage is not exhaustive, it is sufficiently comprehensive to encompass most of the economic activity of the Asian region, and sufficiently diverse to represent each of the archetypical Asian economies with respect to agricultural resource base, stage of agricultural development, and stance towards agricultural assistance.

Agricultural production in each country is dominated by food production. In table 5.1 this is divided into seven categories of commodities: rice, wheat, coarse grains, sugar, dairy, ruminant meat, nonruminant meat.[1]

China has experienced rapid economic growth in recent years. As a result of wide scale liberalization of domestic agricultural pricing policies, growth of the Chinese agricultural sector has matched that of the economy as a whole. Agriculture, which is dominated by rice and wheat, represents about one-third of Chinese GDP and employs three-quarters of the work force.

The three East Asian countries of Japan, Korea, and Taiwan have all experienced high rates of economic growth over the past two decades, although Japan's growth rate has fallen considerably in recent years. Agriculture's share in GDP and employment has declined rapidly in these countries to levels which are very low compared with Asia as a whole. Within the group Korea's agricultural share in GDP and employment is the highest. The rate of growth of agriculture in Korea has increased markedly in the 1980s in response to rapidly escalating protection to that sector (see next section) although agriculture's share of GDP has continued to decline. The sectoral composition of food production in each country is dominated by rice and nonruminant meat.

The ASEAN countries included in table 5.1 have a considerably greater agricultural land base per capita than the three East Asian countries. Although the agricultural sectors of these countries grew substantially over the past two decades, agriculture's growth rate was less than that for the economy as a whole in each country. While agriculture's share of total output and employment in each country has steadily declined, agriculture represents a significantly higher proportion of GDP and total employment in these countries than is the case for East Asia. Rice and sugar are the predominant agricultural activities, with nonruminant meat being particularly important in Thailand and the Philippines.

The West Asian countries in the table have exhibited somewhat lower rates of economic growth than that experienced for Asia as a whole. Although agriculture's share of GDP and employment has declined in each country, agriculture accounts for half of total economic activity in Bangladesh and one-quarter to one-third in Pakistan and India. Agricultural employment represents 55 to 75 percent of the labor force in these countries. In India food production is dominated by rice, wheat, and dairy. In Pakistan wheat and ruminant meat are important, while for Bangladesh rice accounts for over three-quarters of total food production.

Agricultural Protection in Asian Countries

The previous section has highlighted the generally rapid economic expansion achieved by most Asian countries over the past two decades. Average rates of growth throughout much of the region have been more than double those for the world as a whole. This growth performance has been most spectacular for the East Asian countries who have vigorously pursued an outward-looking strategy centered on exports of manufactures. While the rapid industrialization of this part of Asia has resulted in rising national incomes and living standards, it has also imposed severe adjustment pressures on the domestic agricultural sectors of industrializing countries.[2]

These pressures have encouraged increased import penetration of agricultural products and resulted in a decline in agriculture's share of GDP and employment. The policy response of governments to this reduction in agriculture's comparative advantage induced by growth of manufacturing has been to attempt to slow the rate of adjustment out of agriculture by progressively altering the structure of domestic industry incentives in agriculture's favor. In part this policy response has also been motivated in some countries by a desire to achieve a measure of food self-sufficiency irrespective of the domestic resource costs.

Why Do Governments Intervene in Agriculture?

Government intervention in agriculture is a worldwide rather than just an Asian phenomenon. Many studies have examined the reasons why it is so widespread and so vigorously pursued. One proposition with considerable factual support is that, by and large, governments in poor countries tend to tax agriculture relative to other tradable sectors. They do this directly via domestic pricing policies and indirectly by maintaining overvalued exchange rates. This is despite the overwhelming evidence that taxing agriculture in order to free resources to manufacturing distorts comparative advantage in low-income countries and retards economic growth. However, as the process of economic development leads to national income growth, the bias in sectoral policies against agriculture changes to a bias towards agriculture. This change occurs at an earlier stage of economic growth for countries whose agricultural resource base, especially land, and hence comparative advantage in agriculture, is lowest.

Anderson and Hayami (1986) provide an explanation of why countries change from taxing to subsidizing agriculture as their economies grow. Their explanation is centered on the economic theory of politics, the basic axiom of which is that political leaders devise policies to maximize their chances of holding power. The more an interest group expects to gain from a particular policy the greater its demands on government to provide it. Conversely, the more effective the opposition from groups who would lose by that policy, the higher the political cost of supplying it. As per capita incomes grow the decreasing importance of food prices in household expenditure ensures that political pressure for lower food prices diminishes. Manufacturing-led economic growth increases adjustment pressures on agriculture and hence demands by farmers for compensating assistance to reduce these pressures. At the same time the declining relative importance of agriculture in total output and employment makes it less costly politically for governments to accede to farmer pressures.

The proposition that in the course of economic growth governments switch from taxing to subsidizing agriculture is strongly supported by the East Asian experience. There are also signs that it is being followed in ASEAN. Table 5.2 indicates how nominal rates of agricultural protection (measured in terms of the percentage by which domestic producer prices exceed border prices) have escalated in Japan, Korea, and Taiwan since 1955, while over the same period the share of agriculture in GDP in each country has steadily diminished. This coincides with the period of rapid industrialization, and hence increased adjustment pressures on domestic agriculture, experienced by these countries.

In the case of Korea and Taiwan, where the process of industrialization lagged behind Japan, the effects of government sectoral policies were to hold producer prices for agriculture below world prices until as late as the mid-1960s. Since then discrimination in favor of agriculture has grown rapidly to reach extremely high levels, particularly in Korea.

Table 5.2 Nominal Rates of Agricultural Protection in East Asia: 1955–1984

	1955	1960	1965	1970	1975	1980	1984
Nominal rate of agricultural protection[a] (percent)							
Japan	18	41	69	74	76	85	102
Korea	−45	−15	−4	29	30	117	137
Taiwan	−17	−3	−1	2	20	52	43
Share of agriculture in GDP							
Japan	13	10	7	5	4	3	3
Korea	45	40	39	27	22	14	14
Taiwan	28	27	23	15	12	7	6

[a] Defined as the percentage by which the producer price exceeds the border price. The estimates shown are the weighted averages for twelve commodities using production valued at border prices as weights. The twelve commodities are rice, wheat, barley, corn, oats, rye, beef, pork, chicken, eggs, milk, and sugar.
Sources: Hayami (1987) and Honma and Hayami (1986).

Current Rates of Agricultural Assistance in Asian Countries

Table 5.3 provides estimates of rates of assistance afforded each of seven food commodity categories in the ten Asian countries. The estimates refer to the 1980–86 period. They are expressed as ratios of the domestic producer price inclusive of subsidies to the border price. The domestic producer price has been calculated as the world reference price plus the producer subsidy equivalent of assistance per unit of production. The measure of assistance calculated in this way is similar to that provided by the producer subsidy equivalent concept (PSE) used by the OECD and U.S. Department of Agriculture.[3] A ratio of less than one indicates that government policies act to lower the producer price of a particular product relative to the border price.[4] For example, domestic pricing policies for rice in Thailand over the 1980–82 period resulted in the domestic producer price of rice being only 75 percent of the border price. By contrast the producer price of rice to Japanese farmers was estimated at more than five times the border price.

Before interpreting the estimates in table 5.3 it should be emphasized that summary measures of assistance calculated in this way have a limited value for economic interpretation. This is especially so when such measures are considered for a particular sector independent of the degree of assistance received by other sectors. This measure of assistance does not set out the tax effect on an industry of subsidies provided elsewhere in the economy, the

Table 5.3 Estimates of Rates of Agricultural Assistance in Selected Asian Countries: 1980–1986

	North Asia	East Asia			ASEAN			West Asia		
	China[a]	Japan[b]	Korea[a]	Taiwan[a]	Indonesia	Philippines	Thailand	India	Pakistan[c]	Bangladesh[c]
Commodity										
Rice	0.90	6.60	3.05	1.70	0.85[a]	1.00[a]	0.75[a]	0.85[d]	0.75	0.95
Wheat	1.50	10.00	1.10	3.00	1.00[a]	1.00[a]	1.00[a]	0.70[d]	0.90	1.00
Coarse grain	1.30	10.70	2.35	1.60	0.95[a]	1.00[a]	0.95[a]	1.00[c]	0.90	1.00
Sugar	1.15	3.05	4.20	3.45	1.40[a]	1.00[a]	0.90[a]	0.80[c]	0.70	0.60
Dairy	2.90	5.20	2.00	1.50	1.60[c]	1.70[c]	1.60[c]	1.50[c]	1.65	1.30
Ruminant meat	0.75	2.55	3.25	1.55	1.80[c]	1.00[a]	0.95[c]	1.00[c]	1.00	0.90
Nonruminant meat	0.70	1.10	1.30	1.10	2.00[c]	1.25[a]	1.00[a]	1.00[c]	1.00	0.90

Note: The rate of assistance is calculated as the ratio of the domestic producer price inclusive of subsidies to the border price expressed in domestic currency units.

[a] Based on USDA estimates of PSEs for 1984.

[b] Estimates refer to 1986.

[c] Estimates refer to 1980–82.

[d] Based on USDA estimates of PSEs for 1982–1984.

Source: The estimates are taken from Walker (1988). These have been derived by building on the work of Tyers and Phillips (1986) and U.S. Department of Agriculture (1987).

products of which may be purchased as inputs by the industry in question at inflated (subsidy inclusive) prices. In addition, such measures do not take into account the supply and demand responses as a result of the subsidy in the subsidized sector and the flow-on effects to closely related industries and the economy as a whole. They therefore have nothing at all to say about the economic cost of agricultural protection in a particular country in terms of its effect on the level and sectoral composition of economic activity and employment. Nor do they capture what would happen to world commodity prices if protection were removed on either a unilateral or a multilateral basis. To do this requires a framework of analysis which traces the effects of removing such assistance on the behavior of producers and consumers of agricultural products and, through direct and indirect linkages with other sectors, on the economy as a whole.

Despite these caveats, the following points can be drawn from table 5.3.

- With few exceptions (rice in China, Indonesia, Thailand, and West Asia; sugar in Thailand and West Asia; and ruminant meat in China, Thailand, and Bangladesh) producer prices exceed border prices for food commodities in Asian countries, often by very large amounts.

- Rates of assistance are highest in Japan, Korea, and Taiwan across most product groups relative to those in other Asian countries. Assistance is a good deal less in ASEAN countries. With the exception of the dairy group, rates of assistance are negative, zero, or modest in China and the West Asian countries.
- All countries in the region provide high rates of assistance to their domestic dairying sectors.
- Within a particular country the dispersion of assistance rates between agricultural commodities which compete for a common land base is often very large. Hence it is likely that agricultural assistance in these countries, as well as distorting the allocation of resources between agricultural and other activities, is also distorting the input structure and product mix of the agricultural sector. Both the within sector and between sector efficiency losses from this protection may well be large.

The clear message from table 5.3 is that, in terms of the effects of agricultural protection on domestic economic performance in each country, the most interesting Asian countries for detailed study are Japan, Korea, and Taiwan. The Japanese situation is covered in a separate chapter in this volume. In the remainder of this chapter the case of Korea is considered in some detail.

Measuring the Effects of Agricultural Protection in Korea

In the 1950s industry policy in Korea was characterized by import-substituting industrialization. This low-growth strategy was supported by manufacturing tariffs and the direct taxation of domestic agricultural production. This in turn had the effect of holding down domestic food prices and hence the wage demands of industrial workers. Export-oriented industrialization began in the 1960s encouraged by a reduction in manufacturing tariffs and the removal of taxes on agricultural production. Manufacturing was largely based on the transformation of imported raw materials and components into finished or semifinished products for export. This international trade orientation has allowed Korea's manufacturing sector to expand far beyond the limits imposed by reliance on the domestic market. Exports now represent about 38 percent of Korean GDP.

From the mid-1960s to the mid-1970s exports were mainly light manufactured goods, especially textiles, footwear, plywood, and unsophisticated electronic products. Korea has become less competitive in these products as economic development has proceeded. Increasingly, exports have shifted towards heavy industrial goods and more sophisticated electronic equipment.

This manufacturing export growth strategy has been spectacularly successful. At the end of the Korean War in 1953 the Korean economy was dominated by peasant agriculture, which represented about 90 percent of GDP. Average income per head of population was U.S. $450 per year (1987). Throughout the 1950s Korea was one of the world's poorest countries, heavily dependent on U.S. economic aid. In 1987 income per head of population had reached $2,900 and agriculture's share of GDP had fallen to about 14 percent. The rate of economic growth has averaged more than 8 percent annually since the mid-1960s.

For much of the phase of export-led industrialization Korea has maintained significant restrictions against imported manufactured goods in addition to its protection of domestic agriculture. Since 1980 there has been a progressive relaxation of restrictions against manufactured imports so that now there are few substantive import restrictions outside of those on primary products and processed foods. Since the 1970s and in line with the rapid shift in comparative advantage from agriculture to manufacturing, the domestic policy stance towards agriculture has been one of steadily increased protection. The stated government objectives of this policy have been to ensure that (1) the growth in farm incomes keeps pace with the growth in nonfarm incomes, and (2) a high degree of food security is achieved. Ignoring for the present its economic costs, the policy appears to have been moderately successful in achieving its aims (Anderson 1987). The incomes of farm households have maintained parity with the incomes of nonfarm households and a high degree of self-sufficiency in grain production, especially rice, has been achieved, though self-sufficiency in ruminant meat production has fallen. However, the degree of self-sufficiency achieved in agricultural products has necessitated an increasing reliance on imported agricultural inputs, especially fertilizers and animal feedstuffs.

As noted in table 5.3, the achievement of the government policy objectives of farm income parity and food self-sufficiency has involved a steady increase in the wedge between domestic producer (and consumer) prices for food and border prices sustained mainly by tariffs and quantitative restrictions against food imports.[5] The result is that the rate of protection to Korean agriculture as measured by domestic-border price differentials now rivals that of Japan.

Anderson (1987) provides a quantitative assessment of the effects of Korean agricultural protection on food production, consumption, and imports in that country. His analysis is based on a partial equilibrium model of agricultural food markets in Korea. While this model captures the transfers from consumers to producers caused by agricultural protection, it is unable to address the economywide effects of this protection. It is to these effects that we now turn.

An Economywide Model for Korea

The effects of domestic agricultural protection in Korea can be dealt with in a comprehensive manner using an economywide framework. This framework must distinguish the direct linkages, both forward and backward, between agricultural activities, other domestic sectors, and world trade. These so-called input-output linkages specify the inputs of other domestic sectors and overseas suppliers to agriculture and the sales of sector products to the various categories of domestic users and exports. In addition, and perhaps more importantly, the framework must capture the indirect linkages between agriculture and other sectors by recognizing that agriculture competes with other sectors in an economy which is itself subject to overall constraints. Examples are the foreign exchange constraint which requires consistency between the current account outcome and the willingness of the rest of the world to lend to or accept capital from that country, and the constraint on total labor supply. The operation of these and other constraints ensures that the performance of industries is linked irrespective of whatever input-output connections might exist between them. For example, to the extent that increased protection to one sector bids up the price of labor employed by that sector, other sectors must also pay a higher price to attract labor.

To capture the direct and indirect linkages between agriculture, other sectors of the domestic economy, and world trade the Centre for International Economics has developed an economywide general equilibrium model of the Korean economy.[6] This model is of the comparative-static neoclassical type. Its theoretical structure is based on that of the ORANI general equilibrium framework of Dixon et al. (1982). The model is centered on a 1980 system of input-output accounts published by the Bank of Korea. It distinguishes thirteen production sectors, three for agriculture, two other resource-based sectors, five manufacturing sectors, one of which is concerned with food processing, and three service sectors. The choice of sectors reflects the basic orientation of the study (the effects of agricultural protection) and the need to distinguish export- from import-competing activities.

Industry production technology in each sector is depicted by two level nested functions. At the first level different categories of purchased inputs and an aggregate of primary factors are assumed to be used in fixed proportions. At the second level constant elasticity of substitution (CES) is allowed between domestic and imported sources of a particular input category and between the primary factors land, capital, and labor.[7] Each of the agricultural sectors (cereals, other crops, livestock) is modeled as using its own commodity-specific land base, with the model solving for different rental prices on each type of land.[8]

The labor market is characterized by only one type of labor, which is assumed to be mobile across all sectors. In each of the agricultural sectors the labor force is divided between hired workers and family (including owner-operator) labor. This distinction is particularly important. On a persons basis, only 9 percent of the farm labor force is rewarded out of wages paid, with the remainder being rewarded from the gross operating surplus of the farm sector. In the very short term, family labor can be regarded as being immobile in much the same way as farm capital.[9] In the medium term, however, the situation is different, as witnessed by the decline in the farm labor force from about two-thirds of the total labor force in the 1950s to about one-third in the 1980s.

Capital is modeled as being sector-specific in the short term. Relative rates of return on that capital deviate between sectors in response to economic changes. Over the longer term, capital mobility between sectors is assumed to take place to eliminate these deviations. The model contains a simple theory for allocating aggregate investment between sectors.[10] New investment does not augment the capital stock in the short term.

On the demand side, the thirteen categories of domestic and imported products are absorbed by industries, as inputs into current production and capital formation, by households, and by government. Private consumption behavior is depicted by the conventional utility maximization framework. One representative household is assumed to substitute between different categories of consumer goods and between domestic and imported sources of these goods.[11] Government demands are simply indexed to total private consumption demands. Their composition is set exogenously.

Exports are determined according to the differential between domestic costs of exporting industries and world export prices in local currency. Foreign demand curves facing all Korean exports are assumed to be highly elastic.[12] World import prices are assumed independent of Korean import demands.

Macroeconomic behavior is largely exogenous or determined by the way in which the model is closed. Total real domestic absorption (aggregate expenditure by households, government, and private investment) is either set exogenously or determined by the difference between the outcome for real gross domestic product and the balance of trade. The shares of this absorption between component parts are set exogenously. The government's public sector borrowing requirement (PSBR) is always endogenous.

The model incorporates a number of different prices for each activity —producer prices, export prices, and import prices. Margins and taxes levied on commodity flows within the domestic economy are not explicitly modeled.

The nominal exchange rate is the numeraire. While the model is able to explain movements in the real exchange rate, it is unable to explain how much of a given change in the real exchange rate is due to a change in the nominal exchange rate between Korea and the rest of the world on the one hand, or differences in the rate of inflation between Korea and the rest of the world on the other.

The Effects of Removing Agricultural Protection

Agricultural protection in Korea is dominated by the use of quantitative restrictions against imports and to a lesser extent import tariffs. These border protection measures raise producer prices (and hence encourage self-sufficiency and raise farm incomes) well above world prices. Behind this protection, large-scale domestic procurement and price setting programs are operated by the government, particularly in the case of grains.

The domestic implications of agricultural protection in Korea are assessed by using the model to determine the effects of its removal. These effects will depend critically on the nature of the adjustment environment envisaged, in particular: the degree to which labor market gains are shared between increased real wages and increased employment; the extent to which real income gains are shared between increased domestic spending and an improvement in the trade balance; and the degree to which capital is mobile between domestic sectors and between Korea and the rest of the world.

Table 5.4 contains model projections, for a range of variables of interest, of the effects of removing protection to each of the agricultural sectors distinguished—cereals (mainly rice), other crops, and livestock. In the case of the farm-based livestock sector, assistance is provided via protection against imports of livestock products. Based on the rates of assistance estimated for these product categories for the mid-1980s as shown in table 5.3, the removal of protection would result in the following reduction in the power of the tariff and hence local price of competing imports:[13] cereals (61 percent), other crops (67 percent), livestock (69 percent), and food products, which includes livestock products (28 percent).

The table contains two columns of results. They refer to different assumptions about the extent of macroeconomic and labor market adjustment assumed to take place in response to the removal of protection. Both refer to an adjustment horizon in which capital in use in each industry is assumed fixed. Industry investment takes place but is not allowed to augment industry capital stocks. Hence the adjustment horizon refers to a calendar time period long enough for industries to alter their investment plans (and hence the demands faced by industries producing capital goods) in response to changes in their growth prospects following the removal of agricultural protection, but short enough for the effects of new investment on capital stocks to be ignored.

In column 1 the labor market is assumed to be demand-determined with firms able to employ as much labor as they require at a constant nominal wage. The economy's nominal wage is regarded as being set independently of the level of agricultural protection. To the extent that the removal of such protection causes consumer prices to fall, then the purchasing power of the constant nominal wage (i.e., the economywide real wage) will increase.

An alternative assumption would be that workers seek to maintain their real wage. Hence, to the extent that removal of agricultural protection lowers the rate of growth of domestic prices, the rate of growth of nominal wages would be reduced by the same amount.

Labor (both hired and the farm proprietor and family component) is assumed mobile between sectors. At the macroeconomic level real absorption (consisting of aggregate real private consumption, investment, and government expenditure) is also assumed constant. This can be thought of as being achieved by changes in fiscal and/or monetary policies, which are not modeled in this framework. Hence, under this scenario changes in international competitiveness arising from changes in protection affect national income solely through changes in the trade balance.

Table 5.4 Effects of Removing Agricultural Protection (percent)

	Column 1 Constant nominal wages and aggregate real domestic expenditure	Column 2 Constant aggregate labor demand and balance of trade
Macroeconomic		
Real GDP[a]	−0.7	0.2
Real domestic expenditure	0.0	−0.0
Aggregate exports	8.8	12.0
Aggregate imports	9.2	9.5
Balance of trade[b]	−0.9	0.0(Ex)
Consumer price index	−6.2	−7.7
GDP deflator	−4.5	−5.9
Labor market		
Aggregate labor demand	−1.5	0.0(Ex)
Nominal wage	0.0(Ex)	−2.5
Real wage (CPI deflated)	6.2	5.4
Labor's share of national income	5.5	5.2
Industry outputs		
1 Cereals	−22.3	−21.2
2 Other crops	−12.4	−12.0
3 Livestock	−8.7	−8.0
4 Forestry, fishing	−0.7	5.4
5 Mining	1.0	3.4
6 Food, beverages	2.1	2.7
7 Textiles, leather	19.1	21.8
8 Timber and wood products	2.3	4.7
9 Paper, chemicals, etc.	1.6	2.5
10 Manufactures	1.4	3.3
11 Construction	0.1	0.1
12 Margins services	0.3	0.7
13 Other services	1.0	1.5
Major exports		
4 Forestry, fishing	6.2	29.2
7 Textiles, leather	33.5	38.1
8 Timber and wood products	7.5	15.2
10 Manufactures	2.7	6.8
Major imports		
1 Cereals	148.8	145.7
2 Other crops	70.4	71.0
5 Mining	1.5	2.2
6 Food, beverages	−4.6	−7.3
9 Paper, chemicals, etc.	2.0	3.0
Industry employment		
1 Cereals	−61.1	−58.0
2 Other crops	−33.6	−32.4

Table 5.4 continued

	Column 1 Constant nominal wages and aggregate real domestic expenditure	Column 2 Constant aggregate labor demand and balance of trade
3 Livestock	−22.7	−20.7
4 Forestry, fishing	−0.8	6.4
5 Mining	1.2	4.2
6 Food, beverages	4.0	5.0
7 Textiles, leather	31.2	35.6
8 Timber and wood products	2.3	4.7
9 Paper, chemicals, etc.	3.5	5.3
10 Manufactures	2.5	6.0
11 Construction	0.2	0.2
12 Margins services	0.3	0.9
13 Other services	1.3	2.0
Price of land		
1 Cereals	−43.6	−43.7
2 Other crops	−24.0	−25.4
3 Livestock	−16.2	−17.0
Real net farm income[c]		
1 Cereals	−43.8	−42.3
2 Other crops	−21.4	−21.2
3 Livestock	−12.5	−11.7

Note: All results are expressed as percentage changes from the levels that would have been reached assuming no change in agricultural protection.

[a] Calculated from expenditure side.

[b] Expressed as a percentage of base period GDP.

[c] Calculated as a share-weighted average of the nominal returns to land capital and labor employed in each agricultural activity deflated by the model's consumer price index.

(Ex) Denotes variable set exogenously.

In contrast the results in column 2 assume that real wages will adjust to maintain the aggregate employment of labor at the level existing before the removal of border protection to agriculture. Real absorption is assumed to adjust (by way of equi-proportional changes in real household consumption, investment, and government expenditure) to ensure that the balance of trade outcome remains unchanged.

World import prices are assumed fixed, that is, independent of changes in protection to Korean agriculture. While this assumption is reasonable in the context of agricultural trade liberalization by Korea, which is a very small player in world agricultural markets, it would not be appropriate in a study of the effects of global liberalization of agricultural protection.

It is further assumed that to the extent that the removal of agricultural protection improves the economic incentives facing domestic export-oriented activities, export expansion is allowed to take place. That is, additional exports are not suppressed by either existing or new barriers levied against Korea. This assumption is an important one in the context of the present international trading environment. Protectionist policies ranging from import quotas, variable export restraints, countervailing and antidumping duties, and administrative and procedural measures have increasingly been levied against Korean exports in recent years. Korean exports are poorly diversified in terms of product and producer. This makes them especially visible on overseas markets and vulnerable to retaliatory action.[14]

Finally, with the nominal exchange rate as the numeraire, changes in the model's domestic price indexes, for example the consumer price index, can be interpreted as changes in domestic relative to world prices.

Column 1: Constant nominal wages and real domestic expenditure. The direct or first-round effect of the removal of border protection to agriculture is a large reduction in import prices and hence, to a lesser extent, a reduction in domestic producer and consumer prices for agricultural products. Price reductions to these products are passed on through the economy via input-output linkages. As a result, the overall level of domestic costs is reduced. This is shown by the 4.5 percent reduction in the GDP deflator. The reduction in the consumer price index is even more marked (a fall of 6.2 percent), reflecting the larger weighting given to food products in this index. The reduction in Korea's domestic cost structure relative to world prices implies a sharp improvement in the international competitiveness of Korea's traditional export activities and nonagricultural import-competing sectors.

As a result, aggregate exports are projected to expand by 8.8 percent. However, agricultural imports are projected to more than double, resulting in a growth in aggregate imports of 9 percent and hence a small deterioration in the trade balance. With aggregate real domestic expenditure assumed constant, this in turn implies a small decline in real GDP (0.7 percent) and aggregate employment demand. The major reason for the slight decline in overall economic activity and employment is the very large increase in the economywide real wage level (6.2 percent).

At the sector level the very strong boost to imports of agricultural products results in substantial reductions in the output of agriculture (22 percent for cereals, 12 percent for other crops, and 9 percent for livestock).[15] Employment in each of these sectors is projected to fall sharply. Real farm incomes (nominal returns to capital, land, and labor employed in farming, deflated by the model's index of consumer prices) are projected to fall by 44 percent (cereals), 21 percent (other crops), and 13 percent (livestock). A major component of this reduction in farm income is a sharply reduced return to rural land. Agricultural land rental prices are projected to fall by 16 to 44 percent.

The output, employment, and income losses in agriculture are offset by gains in output, employment, and income elsewhere in the economy. These gains are concentrated particularly in manufacturing export activities. The largest percentage increase in exports occurs in the textiles and leather sector. This sector is particularly dependent on imports from the upstream other crops and livestock sectors; hence it benefits directly from the lower domestic prices of both domestic and imported sources of these products following the removal of border protection on competing imports.

A key assumption shaping the above story, particularly the macroeconomic results, is that of constant nominal wages. Under this assumption all of the labor market gains from the removal of agricultural protection are captured by the employed workforce in the form of a 6 percent increase in the economywide real wage. Suppose, for example, that real, rather than nominal, wages were assumed constant. Then our results show that, following the removal of agricultural protection, the improvement in international competitiveness as reflected in the reduction in the GDP deflator is considerably more marked, the first-round effects of lower agricultural prices being reinforced by lower nominal wage growth. As a result, the boost to aggregate exports exceeds the increase in imports, leading to an improvement in real GDP of about 5 percent and an increase in aggregate labor demand of over 8 percent. With real domestic spending assumed constant, all of the gains in national income register as an improvement in the trade balance. This in turn could be used to reduce Korea's foreign debt which, although falling, is still about U.S. $35 billion, equivalent to 30 percent of GNP.

At the sector level the greatly enhanced international competitiveness of exports ensures that the losses to output, employment, and income in agriculture are greatly outweighed by the expansion experienced by export-oriented activities such as textiles and leather, timber and wood products, and manufactures.

Column 2: Constant aggregate employment demand and balance of trade. The results in column 2 (generated under the assumptions of a flexible labor market in which wages adjust to hold employment demand constant, and the adjustment of real domestic spending to match changes in the economy's real income) tell a broadly similar story at the sector level. Under these assumptions the removal of agricultural protection is projected to lead, through heavily increased import penetration of agricultural products, to output contractions in agriculture of 21 percent (cereals), 12 percent (other crops), and 8 percent (livestock). Employment in agriculture is projected to fall by 58 percent (cereals), 32 percent (other crops), and 21 percent (livestock). Real net farm incomes are projected to fall by 42 percent (cereals), 21 percent (other crops), and 12 percent (livestock). Labor released from agriculture is reemployed in the traditional export-oriented sectors which experience export-led output and employment growth.

With capital fixed in aggregate and by sector, and labor fixed in aggregate, real GDP increases only slightly. However, there are significant changes in the composition of this GDP between returns to labor and returns to capital and land. The removal of agricultural protection results in sharp reductions in the returns to capital and land employed in agriculture.[16]

Wage earners appropriate these agricultural income losses in the form of a 5 percent increase in the economywide real wage and hence a similar increase in the share of the national income going to labor. This gain in the average wage level in the economy results as labor is released from agriculture, where its average wage is low, to sectors in which its average wage is high.[17]

Notes

The author is grateful to Kwang-ho Choi, Lisa Rutström, Glenn Harrison, and other participants at the November 1987 San Diego workshop, for helpful comments on an earlier version of this chapter.

1. Most categories are self-explanatory. Coarse grain includes barley, oats, and sorghum. Ruminant meat includes beef and sheep meats. Nonruminant meat includes pig meat and poultry.

2. The development process experienced by these countries is analogous to what has become known as the economics of booming sectors. According to this theory, the rapid emergence of, say, manufacturing exports, will, via an appreciation of the real exchange rate, act in much the same way as a reduction in protection to import-competing activities. See Gregory (1976) and Corden (1981) for examples of this theory in the context of Australian mineral export growth and the exploitation of North Sea energy.

3. In percentage form PSEs are generally expressed as the ratio of the per unit PSE to the relevant domestic market price.

4. The border price is defined as the fob export price or the cif import price depending on whether the country is judged to be a net exporter or importer of the product in the absence of its distortionary food policies.

5. Government subsidies on farm inputs, in particular agricultural credit concessions and government-financed infrastructure developments, have also encouraged resources to remain in agriculture as agriculture's comparative advantage has declined.

6. A technical appendix describing this model is available from the Centre for International Economics.

7. The resultant intermediate input and primary factor input demand relationships require estimates of the elasticity of substitution between factors of production in each industry and between domestic and imported sources of each commodity category. The former are based on the Korean industry production function studies of Nam (1975) and Kim (1977) and range from 0.8 (manufacturing and services) to 1.4 (agriculture). The latter are judgmental, 2.0 (manufacturing) and 5.0 (agricultural products) being within the range indicated by the few available published studies for other countries.

8. While there is some multiproduct land use in Korean agriculture, a reasonably clear distinction exists between paddy land, other more undulating cropland, and hill grazing land. Livestock production is becoming increasingly specialized on grazing land.

9. This can be modeled by treating family labor as a fixed factor of production.

10. This theory ensures that industries which experience the most pronounced increases in their rates of return to capital obtain increased shares of aggregate investment. See Dixon et al. (1982).

11. The utility function is assumed to be of the Klein-Rubin form. Own, cross price, and expenditure elasticities of demand are derived from Lluch, Powell, and Williams (1977), who applied Lluch's extended linear expenditure system to Korean National Accounts data for the period 1963–72.

12. This is captured by setting all export demand elasticities to −20.0.

13. The power of the tariff is defined here as one plus the ad valorem equivalent of tariffs and other quantitative restrictions against imports. This model variable can be used to capture the domestic-world price distortion imposed by agricultural protection. The size of the shift in the power of the tariff needed to reflect the shift in domestic producer prices relative to the world price was calculated using the information on domestic-world price distortions in table 5.3. For each of the model industries—cereals, other crops, livestock, and food products—the appropriate change in the power of the tariff was arrived at by weighting, using output weights the size of the domestic-world price distortion for products classified to these sectors.

14. About 40 percent of Korea's exports are sold on the U.S. market.

15. A key factor determining the output responses of industries concerns their output supply elasticities. With capital and land in each sector assumed fixed, the output supply elasticity for sector j (Z_j) is given by

$$Z_j = B_j S_{vj} / (1\text{-}S_{vj}) \, [1/S_{pj}]$$

where B_j is the CES substitution elasticity between primary factors in industry j, S_{vj} is the share of variable factor costs (i.e., labor) in j's primary factor costs, and S_{pj} is the share of primary factor costs in total costs. Values for Z_j in agriculture are 0.10 (cereals), 0.19 (other crops), and 0.90 (livestock). The main reason for the much higher short-run supply elasticity for livestock is its considerably greater share of material inputs (principally livestock feed) in its total costs.

Despite its much higher supply elasticity, the livestock sector shows a smaller output response than the cropping sectors because of a much smaller reduction in its output price. By comparison with cereals and other crops, the livestock sector does not face as much direct competition from imports (base period import share of domestic usage of only 4 percent compared with 15 to 20 percent for other agriculture). The livestock sector faces indirect competition from imports through its sales to the food and beverages sector for processing. The output of the food and beverages sector is projected to rise by about 2 percent, thereby increasing this sector's demand for livestock inputs, most of which are supplied domestically.

16. According to estimates from the Bank of Korea, about 60 percent of value added in Korean agriculture in the early 1980s was in the form of a return to agricultural land.

17. Much of the rewards to those engaged in agriculture are in the form of returns to agricultural land. The average wage payment per person employed in agriculture in the base economy is only about one-quarter of that in other sectors.

References

Anderson, K. 1987. Food policy in Korea, 1955–1985. In *Food pricing policy in Asia*, ed. T. Sicular. Ithaca: Cornell Univ. Press.

Anderson, K. and Y. Hayami, eds. 1986. *The political economy of agricultural protection*. Sydney, Australia: Allen and Unwin.

Corden, W. M. 1981. The exchange rate, monetary policy and North Sea oil: The economic theory of the squeeze on tradeables. *Oxford Economic Papers* 36:359–80.

Dixon, P. B., B. R. Parmenter, J. Sutton, and D. P. Vincent. 1982. *ORANI: A multisectoral model of the Australian economy*. Amsterdam: North-Holland Publishing Co.

Gregory, R. 1976. Some implications of the growth of the minerals sector. *Australian Journal of Agricultural Economics* 20(2): 71–91.

Hayami, Y. 1987. Japanese agriculture under siege. Tokyo (unpublished).

Honma, Y., and Y. Hayami. 1986. The determinants of agricultural protection levels: An economic analysis. In *The political economy of agricultural protection*, ed. K. Anderson and Y. Hayami, 39–49. Sydney, Australia: Allen and Unwin.

Kim, Y. S. 1977. Factor substitutability, efficiency growth and relative wage income shares in the Korean agricultural and manufacturing sectors, 1955–1974. Ph.D. diss., Michigan State Univ.

Lluch, C., A. A. Powell, and R. A. Williams. 1977. *Patterns in household demand and saving*. New York: Oxford Univ. Press.

Nam, C. 1975. Economies of scale and production functions in South Korean manufacturing. Ph.D. diss., Univ. of Minnesota.

OECD. 1987. *National policies and agricultural trade*. Paris.

Tyers, R., and P. Phillips. 1986. Distortions in world food markets, annexe A: Historical trends in grain, livestock and sugar markets, the quantity data. Australian National Univ., Canberra. Mimeo.

Walker, A. 1988. World agricultural trade distortions—Measurement and recent trends. Paper presented at the Conference of the Australian Agricultural Economics Society, February, Melbourne.

U.S. Department of Agriculture. 1987. *Government intervention in agriculture: Measurement, evaluation, and implications for trade negotiations*. FAER no. 229. Washington, D.C.

World Bank. 1987. *World development report 1987*. New York: Oxford Univ. Press.

6. Effects of Agricultural Protection in Japan: An Economywide Analysis

David Vincent

Summary

Japan is now the world's largest importer of agricultural products. Yet agricultural imports into Japan are more restricted than in any other OECD country. The main instruments of protection for the Japanese agricultural sector are quantitative restrictions against imports and, to a lesser extent, import tariffs and domestic subsidies to farm inputs.

As a result of border protection measures, domestic producer prices for Japanese grains in 1986 were on average 420 percent above world prices. The corresponding margin for livestock products averaged 116 percent.

While government protection of Japanese agriculture has a long history, the major expansion in protection has occurred since the mid-1950s, the beginning of the rapid export-led growth of Japanese manufacturing and hence steady decline in agricultural comparative advantage. Underlying the government's policy response of increasing agricultural protection have been the notions of food security and parity between farm and nonfarm incomes.

Foreign critics of Japan's trade policies give particular emphasis to a lowering of import barriers to agricultural products. While concessions in this area by Japan would provide an important signal to the rest of the world of Japan's preparedness to liberalize its trading regime, domestic forces opposing the reform of agricultural protection remain strong. Around 20 percent of Japanese households are farm based with farmers (many of which are part-time) a potent political force.

Nevertheless, there are powerful domestic interest groups outside agriculture with an interest in the reform of agricultural protection. What is needed is support for such groups in the form of a better understanding of the domestic effects of Japanese agricultural protection, in particular the extent to which such protection operates as a tax on the economic performance of other sectors of the Japanese economy. To date no such analysis along these lines has been published.

The domestic costs of agricultural protection, in particular its effects on other domestic sectors, are assessed here. The analytical framework used is a multisectoral economywide model which incorporates the direct and indirect linkages within and between agriculture, other domestic sectors, and Japanese international trading performance. The results emphasize the way in which agricultural protection, by raising domestic costs and hence decreasing the purchasing power of a given nominal wage, acts to reduce significantly the living standards of wage earners.

Increased domestic costs relative to world prices imply reduced international competitiveness of nonagricultural traded activities, especially Japanese manufacturing. Our projections show that a major part of the bad news is in the form of an implicit tax on Japanese manufacturing, particularly the sectors producing and exporting transport equipment, other machinery, mineral and metal products, and chemical products. This tax is sufficient to curtail manufacturing export earnings by about 3 percent on average, equivalent to about 1.2 trillion yen (in 1985 prices). This leads to reductions in output in these sectors over the short to medium term of between 0.3 and 2 percent and reductions in manufacturing employment demand of from 0.4 to 4 percent.

An alternative way of viewing agricultural protection is in terms of its effects in a macroeconomic environment in which the economy's average real wage level is assumed to adjust to ensure constant aggregate employment, and in which induced changes in aggregate spending are equivalent to induced changes in aggregate income, such that the outcome for the balance of trade does not change. In this environment the effects of agricultural protection at the sector level are much the same as those described above. The boost to output, employment, and income in agriculture through heavily reduced agricultural imports is offset by greatly diminished manufacturing export performance and hence a reduction in output, employment, and income in export-oriented manufacturing activities.

Overall macroeconomic performance is also diminished. There is a small reduction in the economy's real income, and hence the level of real spending that it can sustain, and a reduction in the average real wage level of 2.5 percent—equivalent to about 101,000 yen per worker in 1984. That is, a particularly important consequence of Japanese agricultural protection is to reallocate significantly a diminished aggregate income away from Japanese wage earners and towards the owners of rural land. The rental price of rural land is raised by about 68 percent.

In recent years Japan has accumulated a massive surplus of exports over imports. Pressures from the United States in particular for Japanese agricultural trade liberalization have intensified as Japan's current account surplus has continued to grow contemporaneously with the large trade deficits of the United States. It is tempting, though incorrect, to regard Japanese agricultural protection as a contributing factor in this surplus.

While our analysis shows that imports of Japanese agriculture would increase by over 90 percent if domestic protection were removed, Japanese manufacturing export earnings would also increase significantly. In fact, if the labor market gains were appropriated not by higher real wages but by increased employment, then Japan's trade surplus would increase. That is, the tax effect on aggregate export earnings from agricultural protection exceeds the savings in aggregate import expenditures from such protection.

The fundamental cause of Japan's current account surplus is too little spending relative to income, implying a surplus of domestic savings over that needed by domestic investment at home. The analysis shows that the removal of this surplus through a balanced increase in domestic spending would have adverse effects on Japanese agriculture. Put another way, the continuation by Japan of a trade surplus is favorable to Japanese agriculture in the sense that if this surplus were eliminated, either Japanese agriculture would contract or, to prevent this contraction taking place, the rate of protection required by Japanese agriculture would need to be increased.

Introduction

Japan is now the world's second largest economy. It is also the world's largest importer of agricultural products. Despite this Japan has a domestic agricultural sector which is highly protected from import competition. The level of protection has escalated in recent years to the point where Japanese agriculture is now considerably more highly protected than the agricultural sectors of any of the other major industrial countries (OECD 1987).

The heavy protection given to Japanese agriculture has important implications for both the domestic economy and the international trading system. It is trite, nevertheless important, to emphasize that every part of domestic economic activity is linked to every other part. These linkages occur through product market purchases and sales, through factor markets, through the relationship between aggregate income and expenditure, and hence the balance of trade, and through institutional arrangements such as labor market settings.

Because of such linkages, assistance to Japanese agriculture must inexorably involve a tax on other more lightly protected sectors of domestic economic activity, namely, manufacturing. This protection for agriculture in turn alters both the level and sectoral distribution of economic activity and employment in Japan, and, through different factor intensities across sectors, the distribution of national income between labor, the owners of manufacturing capital, and the owners of rural land.

At the international level Japanese agricultural protection has several important consequences. First, it is a major source of friction between Japan and her trading partners, particularly agricultural exporters such as the United States and Australia. Pressures from the United States in particular for Japanese agricultural trade liberalization have intensified as Japan's current account surplus has continued to grow hand in hand with the large trade deficits of the United States. Given the substantial share of world economic activity encompassed by Japan and the United States, the threat of retaliatory action, if carried out, has the potential to damage the world trading system well beyond agriculture.

Second, because Japanese agriculture is heavily protected relative to Japanese manufacturing, such protection, as well as operating to tax the exports to Japan of agricultural products, in effect acts as a subsidy to foreign suppliers of manufactured goods on the world market.

This chapter discusses two main issues concerning Japanese agricultural protection. The first issue, taken up in the next section, is concerned with how Japanese agricultural protection has developed in the postwar period, the reasons for its development, and the level it has now reached. The second, which forms the subject of the third section, is concerned with the costs to the Japanese economy of this protection in terms of diminished macroeconomic performance and living standards; also discussed are the extent to which protection has restricted the economic performance of more efficient domestic activities such as manufacturing and reduced the earning of factors of production employed outside agriculture.

This analysis of the effects of Japanese agricultural protection is performed at a time of large and persistent trade imbalances in the world economy. Japan, with export earnings twice the size of expenditure on imports in fiscal year 1986, yielding a trade surplus of U.S. $100 billion, or around 4.3 percent of GNP, is at the center of this international economic disequilibrium. Until this disequilibrium is resolved, it will continue to cast a long shadow over prospects for the world economy. It is therefore timely to consider the issue of what role, if any, Japanese agricultural protection has played in Japan's current account surplus and the contribution the dismantling of such protection might make towards arresting the Japanese current account imbalance. This is done in the final section of this chapter.

Agricultural Protection in Japan

History

Government intervention to protect Japanese agriculture from import competition has a long history. In reviewing this history Hayami (1987) draws attention to the 15 percent tariff imposed on imported rice in 1905—initially a revenue measure to help finance the 1904–5 war with Russia, but retained as a long-term protective device after lobbying from land interests. Following the rice riots of 1918, an imperial food self-sufficiency policy was implemented. A key feature of this policy involved the development of rice growing in the then Japanese colonies of Korea and Taiwan. This provided a means of meeting the growing demand for food over and above that which could be provided by the adoption of land-saving agricultural technology on the Japanese mainland. Rice imported from these territories entered free of duty.

The major expansion in Japanese agricultural protection has occurred since the mid-1950s. This marked the start of the rapid export-led industrialization of Japanese manufacturing and hence a steady decline in the comparative advantage of agriculture. The government's response was to provide offsetting assistance to agriculture in steadily increasing amounts, thereby ensuring that part of the adjustment, which would otherwise have been borne by the farm sector, was passed back on to the other sectors of the economy.

Underlying the government's policy response were the notions of (1) food security, if not food self-sufficiency, and (2) equity expressed in terms of parity between farm and nonfarm incomes. In 1961 the Agricultural Basic

Law was passed in which the government accepted responsibility to raise agricultural productivity and thereby close the income gap between farm and nonfarm. Despite positive efforts at structural adjustment, the rate of agricultural productivity growth was not in itself sufficient to close this gap. Farmers sought, and were granted, additional protection to achieve this —initially through high domestic prices for rice. In recent years farm and nonfarm income parity has been achieved through steadily escalating protection and a significant shift to part-time farming made possible by the growth in off-the-farm employment opportunities.[1]

Despite this increased protection, agricultural production has not kept pace with the growth in domestic demand for agricultural products, so that the level of agricultural self-sufficiency is steadily declining.[2]

Level of Protection to Japanese Agriculture

An indication of the level of protection received by a particular sector can be obtained by reference to a number of summary measures. One such measure frequently used to this end is the nominal rate of protection. This measure reflects the extent to which assistance raises the producer price of the product above the world price at the border. While this measure incorporates assistance arrangements which impact on the output price it does not take account of assistance provided by subsidies to inputs. Nor does it incorporate penalties (negative subsidies) on inputs which may arise through protection to other products in the economy used as inputs by agriculture.

Table 6.1 shows how agricultural protection, as measured by the percentage by which the producer price exceeds the border price, has increased in Japan since 1955. For example, in 1955 the producer price of rice was 24 percent above the border price. By 1980 this price differential had risen to 192 percent and by 1986 to 414 percent. Protection is large, and has grown most quickly, for the more land intensive commodities. This reflects Japan's scarce endowment of land relative to capital and, hence, lower comparative advantage in this part of agriculture.

An alternative measure of the degree of protection—one which has been strongly promoted in the context of agriculture by the OECD and the U.S. Department of Agriculture—is the producer subsidy equivalent (PSE).[3] Because it incorporates assistance provided to agricultural inputs, this measure is somewhat broader than the nominal rate of protection measure.

Input subsidies, particularly those concerning infrastructure development,

Table 6.1 Nominal Rates of Protection in Japan for Selected Agricultural Commodities, 1955–1986

Commodity (percent)	1955	1960	1970	1980	1984	1986
Grains						
Rice	24	47	135	192	235	414
Wheat	31	51	134	261	318	541
Barley	24	52	158	307	363	611
Average (all grains)	24	48	135	196	239	420
Livestock products						
Beef	39	84	108	100	103	211
Pork	2	97	−9	17	21	86
Chicken	−52	19	18	23	9	67
Eggs	−19	−7	−9	−1	−7	42
Milk	4	5	212	186	185	338
Average (all livestock products)	−8	22	24	40	41	116

Source: Hayami (1987).

are a significant form of assistance to Japanese agriculture. According to estimates compiled by the EC Commission in the early 1980s, the ratio of agricultural subsidies (current plus capital) to agricultural GDP in Japan was about 33 percent. Measures of Japanese agricultural protection based on the PSE concept, which include input subsidies, are generally higher than the nominal rate of protection estimates of table 6.1. For example, estimates by Walker (1988) on a PSE basis (value of assistance as a percentage of the unassisted producer value of production) are as follows: rice (565), wheat (285), dairy products (235), ruminant meats (mainly beef) (240), and nonruminant meats (mainly pork, chicken) (110).

Forms of Agricultural Protection

Agricultural protection in Japan is provided by two types of instruments—border protection measures and domestic subsidies. Protection from imports in turn allows a complex system of internal price supports to be maintained. The system for rice, for example, involves, in addition to price support, area restrictions and marketing regulations.

Border protection. Border protection measures are mainly in the form of quantitative restrictions against imports. In addition there is a regime of import tariffs, though tariff rates are low in ad valorem terms. Dairy products, beef and processed meat products, flour and cereal products, fresh and processed fruit and vegetable products, and sugars are all subject to import quotas administered by the Ministry of Agriculture, Forestry, and Fisheries. For some products, imports are controlled by government or semigovernment trading agencies—e.g., rice, wheat, and barley by the Food Agency and beef, butter, and powdered milk by the Livestock Industry Promotion Corporation.

Tariffs are a good deal less important than quantitative restrictions. According to the Japanese Ministry of Agriculture, Forestry, and Fisheries, the average tariff rate on imported agricultural commodities was 8.6 percent in 1984 (Hayami 1987).

The tariff equivalent of the amount of protection provided by quantitative restrictions set at a particular level, as measured by the extent to which domestic prices are raised above world prices, will fluctuate over time in response to movements in the world price in foreign currency and the exchange rate. To the extent that the yen appreciates against the currency in which world agricultural commodity prices are denominated, then the amount of protection delivered by the quota increases. Given the 28 percent appreciation of the yen against the U.S. dollar over calendar year 1987, this suggests that the nominal rates of protection, as measured for 1986 in table 6.1, will now be distinctly higher. As such, the effects of agricultural protection on the Japanese economy reported in this study could be considered conservative.

Input subsidies. Input subsidies are used extensively in Japanese agriculture. They are particularly important in financing agricultural investment, especially in infrastructure. In the early 1980s the ratio of current subsidies to agricultural GDP was about 9 percent and the ratio of total subsidies (current plus capital) to agricultural GDP about 33 percent (Hayami 1987).

It is difficult to ascertain how effective these subsidies are in reducing agricultural production costs and hence improving farm output and incomes. Some component of them would be nonproductive in this sense. In recent years there has been a reduction in agricultural subsidies as a result of tighter government fiscal policy to reduce the budget deficit. According to recent OECD estimates (OECD 1987), expenditure on agriculture as a percentage of total government outlays is about 3 percent in Japan. This compares with a figure of about 4 percent for the United States.

Measuring the Effects of Japanese Agricultural Protection

The summary measures of protection referred to earlier are useful indicators of the size of the wedge between the domestic producer price and the border price caused by agricultural protection. However, they do not incorporate the supply and demand responses to this price wedge by the sector concerned and the flow-on effects in the economy. They therefore have nothing to say about the effects of such protection on commonly used indicators of economic performance such as output, employment, and income in the sector being protected, in other domestic sectors, and for the economy as a whole. To do this requires interfacing the protection measures with a framework which allows for economic responses. The simplest of these is the partial equilibrium framework.

Several studies have used a partial equilibrium framework to estimate the welfare costs of Japanese agricultural protection at the much lower levels which existed in the 1970s and early 1980s. Examples are O'Mara et al. (1981) for 1978 levels of protection, Bale and Lutz (1981) for 1976 levels of protection, and Tyers and Anderson (1986) for 1979–80 levels of protection. Although the partial equilibrium framework provides a useful approach, it cannot answer the central question posed in this study—what are the economywide consequences of high agricultural protection in Japan? The reason is that partial analysis does not incorporate linkages, both direct and indirect, between agriculture, other domestic sectors, and world trade. Without these linkages such an approach is unable to capture the spillover effects of agricultural protection on other domestic sectors and the economy as a whole, and the way in which these feed back to modify agricultural outcomes. In short, the partial equilibrium framework is unable to deal in any comprehensive way with the real opportunity costs of agricultural protection and hence the incentives for Japan to reverse unilaterally such policies. To do this an economywide framework with sectoral detail is required.

An Economywide Model for Japan

The domestic costs of Japanese agricultural protection are assessed in this chapter using an economywide model. This model incorporates the direct and indirect linkages between agriculture, other domestic sectors, and Japanese international trading performance.

The model developed here is of the comparative-static neoclassical type.

It is derived from the ORANI general equilibrium framework of Dixon et al. (1982). This basic framework also lies behind the Korean model (Vincent 1989) and the West German model (Dicke et al. 1989), companion papers of the overall global agricultural trade liberalization study. The model's interindustry, factor market and trade linkages are derived from a 1980 system of input-output accounts for Japan. These are interfaced with agricultural protection estimates for 1986.

The model distinguishes nineteen production sectors. There are two types of agriculture (crops, livestock), three additional primary sectors (forestry and fishing, crude oil, other mining), and two downstream food-processing activities (livestock products, which include beef, pork, and poultry; other food products, which function as a major purchaser of agricultural crops). These allow for the modeling of various instruments of agricultural protection which are applied at the farm level or downstream. For example, production subsidies are applied at the farm level but some import quotas such as those for beef are applied at the livestock product level.

Eight additional manufacturing sectors are distinguished (textiles; pulp, paper, printing; chemical products; petroleum products; mineral and metal products; machinery; transport equipment; other industrial). In addition to its primary role of analyzing the effects of Japan's domestic protection policies, the model is well suited to handling the effects on Japan of changes in the world economy such as, for example, changes in world oil prices or changes in the world demand for motor vehicles.

Service activities are divided into four sectors (construction, transport and communication, government services, other private services). Expansion in some or all of these essentially nontraded activities provides one way in which Japan might seek to correct its present balance of trade surplus.

The theoretical structure of the Japanese model is simple and orthodox.[4] Producers in each sector are assumed to minimize their costs subject to neoclassical production functions of a two-level nested form. At the first level different categories of purchased inputs and an aggregate of primary factors are assumed to be used in fixed proportions. At the second level substitution is allowed, according to CES functions, between domestic and imported sources of each intermediate input and between the three types of primary factors distinguished—capital, labor, and rural land. Two types of land are distinguished—cropping land and grazing land. These are industry-specific. The model provides projections of the effects on the rental price of each type of land due to changes in agricultural protection.

The inclusion of a treatment of rural land is particularly important. One of the important consequences of Japanese agricultural protection is its effect on land prices and hence the cost of private dwellings and land-based recreation facilities. High land prices in turn restrain aggregate private expenditure on these items, making it more difficult for Japan to correct its aggregate income-expenditure imbalance.

The labor market is characterized by only one type of labor, which is assumed to be mobile between sectors. In agriculture the distinction is made between hired workers, self-employed, and unpaid family workers. Only about 3 percent of the work force engaged in agriculture is hired labor. The remaining 97 percent, consisting of self-employed and unpaid family workers, are rewarded from the gross operating surplus of farm activities. In the very short term, self-employed labor can be regarded as immobile and is modeled as such by treating it as part of the farm capital stock. This is not the case over the medium term, as witnessed by the considerable changes which have occurred in the farm labor force. For example, between 1960 and 1985 the number of full-time farmers fell by about 60 percent. However, the number of part-time farmers increased by about 70 percent, reflecting increased off farm employment opportunities within commuting distance. Overall the number of persons engaged in agriculture fell by about 44 percent.[5]

Model closure options allow for several treatments of the other primary factor, capital. One option, more relevant for the short-to-medium term, is to consider the quantity of capital in each sector as fixed. Under this option industry-specific rates of return to this capital respond differently to the change under study. A second option, more applicable to the longer term, is to allow capital mobility between sectors to eliminate these changes in industry specific relative rates of return on capital.

Aggregate investment is either set exogenously or determined as a fixed share of total real domestic absorption (aggregate expenditure by households, government, and private investment). Aggregate investment determined in this way is allocated among sectors according to changes in industry rates of return.[6]

The model contains a full treatment of demands for each of the nineteen domestic and imported products. These are used as inputs into the production of current and capital goods, produced and consumed by households and by government, and exported. Prospects for relative price-induced substitution between domestic and imported sources of each product in each of the uses, the production of current goods, the production of investment goods, and household consumption are described by Armington elasticities of substitution.[7]

Household consumption behavior is depicted by the conventional utility maximization framework. A representative household is assumed to substitute between the different categories of consumer goods and between domestic and imported sources of each category.[8] There is no behavioral theory of government demands. These are simply indexed to aggregate private consumption.

Exports are determined according to the differential between domestic costs of exporting industries and world prices in local currency. Export demands are assumed to be fixed in the case of textiles, highly elastic in the case of those products for which Japan's exports represent an insignificant part of world trade, and moderately elastic in the case of the major Japanese export items.[9] World import prices are assumed independent of Japanese import demands. Market-clearing relationships equate demands with supplies for domestic commodities. They also require that factor demands be satisfied though not necessarily at full employment levels.

The model distinguishes a number of different prices for each activity —producer prices, export prices, and import prices. Margins and taxes levied on commodity flows within the domestic economy are not explicitly modeled. Since constant returns to scale and competitive behavior are assumed, profits accrue only to factors of production. Zero pure-profits conditions equate prices with costs for each of the activities—current production, capital creation, exporting and importing.

In the experiments reported later, the nominal exchange rate performs the role of numeraire. That is, while the model determines the implications for the real exchange rate of a specified policy shock it is unable to explain how much of this change is due to a change in the value of the yen against foreign currencies or a change in the rate of inflation between Japan and her trading partners.

There is no built-in macroeconomic closure. Total real domestic absorption can be set exogenously or determined by the difference between the outcomes for real gross domestic product and the balance of trade. The shares of this absorption between private consumption, government expenditure, and private investment are set exogenously. There is no explicit accounting of the net revenue position of the government sector. Hence the government's public sector borrowing requirement can be regarded as being always endogenous. This is of little consequence to the overall results, as government outlays on agricultural protection, although prominent when compared with agricultural value added, represent less than 3 percent of total government outlays.

Effects of Removing Agricultural Protection

We concentrate on the implications of removing Japanese agricultural protection for the economic performance of agriculture, other domestic sectors, and the Japanese economy as a whole in the context of a short-to-medium term adjustment horizon. This is defined by the assumption that capital in use in each industry remains fixed. Labor, both owner-operator and hired, is, however, free to move between sectors. While industries respond differently in terms of investment, any new investment or disinvestment is assumed not to augment the capital stock. In this environment one effect of the removal of agricultural protection is to change existing differentials between industry rates of return to capital. In an environment of longer term adjustment these induced differences could be expected to be diffused by capital flows between sectors.

Within this short-to-medium term adjustment environment we consider two alternative scenarios. They differ according to the treatment of the labor market and the determination of the split between national income and expenditure.

In scenario A we consider the labor market to be characterized by constant nominal wages.[10] Hence, to the extent that the removal of agricultural protection lowers domestic food prices, workers will appropriate some of the gains in the form of higher real wages. The assumption of constant nominal wages is critical to the results in scenario A. We illustrate this by contrasting these results with those under the polar assumption of constant real wages.

We also consider the level of real aggregate domestic expenditure in the economy (aggregate private consumption, investment, and government spending) to remain constant. Hence, any changes in national income following the elimination of agricultural protection show up as changes in the balance of trade. This closure therefore captures the extent to which agricultural protection operates to reduce the international competitiveness of Japanese manufacturing.

In scenario B the labor market and aggregate expenditure assumptions are reversed. In the case of the labor market, wages are assumed to adjust to ensure that the economy's total demand for labor remains constant. Similarly, the level of real expenditure is assumed to adjust to ensure that the outcome for the balance of trade is unchanged.[11] That is, the change in aggregate expenditure is equivalent to the change in aggregate income caused by the removal of agricultural protection.

The Extent of Assistance to Be Removed

For scenarios A and B we analyze the effects of (1) removing domestic subsidies to the two land-based agricultural industries—agricultural crops and livestock; and (2) removing border protection (tariffs and the tariff equivalent of import restrictions) to the products which compete with imports in the following industries: agricultural crops, livestock products (in which beef and other meat imports are classified as competing products), and other food products (which include milled grains and refined sugar).

We take Hayami's estimate for the early 1980s that subsidies on current inputs to agriculture represented on average about 9 percent of agricultural GDP. The removal of subsidies is simulated by increasing the unit costs of production of agricultural crops and livestock by this equivalent. In the case of border protection measures, we take as our starting point the 1986 estimates in table 6.1 for nominal rates of protection: 420 percent for agricultural crops and 116 percent for livestock products. We then calculate the percentage reduction in the power of the tariff, and hence local price of competing imports that would occur for these sectors and for sector 7 (other food products) if such protection were removed.[12] These represent the exogenous shocks driving the results.

The Results

Table 6.2 contains projections of the separate and combined effects on the performance of the macroeconomy, agriculture, and other sectors of removing subsidies to agriculture and border protection for agricultural products. It is important to emphasize the comparative-static interpretation of these projections. They represent the percentage changes in the levels of the variables due solely to the removal of assistance. Thus the figure in line 3, column 3 shows that, after a short-to-medium-term adjustment period, Japan's aggregate foreign currency export earnings would be 3.2 percent higher

Table 6.2 Projections of the Short-to-Medium-Term Impact of Removing Agricultural Protection (percent)

	Scenario A Constant nominal wages and aggregate real domestic expenditure			Scenario B Constant aggregate employment demand and balance of trade		
Variable	Remove subsidies	Remove border protection	Total[a]	Remove subsidies	Remove border protection	Total[a]
Macroeconomic						
Real GDP[b]	−0.07	−0.24	−0.31	0.00	0.12	0.12
Real domestic expenditure	0.00(Ex)	0.00(Ex)	0.00(Ex)	−0.00	0.02	0.02
Aggregate exports (foreign currency)	−0.08	3.24	3.16	0.43	5.66	6.09
Aggregate imports (foreign currency)	0.37	5.07	5.44	0.39	5.20	5.59
Balance of trade[c]	−0.07	−0.31	−0.38	0.00(Ex)	0.00(Ex)	0.00(Ex)
Consumer price index	0.16	−3.05	−2.89	0.05	−3.57	−3.52
GDP deflator	0.10	−2.10	−2.00	−0.03	−2.70	−2.73
Labor market						
Aggregate labor demand	−0.11	−0.61	−0.72	0.00(Ex)	0.00(Ex)	−0.00(Ex)
Nominal wage	0.00(Ex)	0.00(Ex)	0.00(Ex)	−0.18	−0.88	−1.06
Real wage (CPI deflated)	−0.16	3.05	2.89	−0.23	2.70	2.47
Labor's share of national income	−0.20	2.68	2.48	−0.23	2.58	2.35
Industry outputs						
1 Agricultural crops	−2.00	−16.49	−18.49	−1.95	−16.26	−18.21
2 Livestock	−1.21	1.31	0.10	−1.16	1.56	0.40
3 Forestry, fishing	−0.24	0.18	−0.06	−0.18	0.43	0.25
4 Mining	−0.02	0.32	0.30	0.07	0.79	0.86
5 Crude oil	−0.02	0.31	0.29	0.11	0.96	1.07
6 Livestock products	−1.13	−0.09	−1.21	−1.08	0.19	−0.89
7 Other food products	−0.39	5.14	4.75	−0.36	5.28	4.92
8 Textiles	−0.03	1.84	1.81	−0.01	1.98	1.97
9 Pulp, paper, etc.	−0.01	−0.12	−0.13	0.03	0.13	0.16
10 Chemical products	−0.11	2.15	2.04	0.12	3.21	3.33
11 Petroleum products	−0.05	0.13	0.08	0.08	0.77	0.85
12 Mineral and metal products	−0.04	0.53	0.49	0.10	1.07	1.27

Table 6.2 continued

Variable	Scenario A Constant nominal wages and aggregate real domestic expenditure			Scenario B Constant aggregate employment demand and balance of trade		
	Remove subsidies	Remove border protection	Total[a]	Remove subsidies	Remove border protection	Total[a]
13 Machinery	−0.04	0.51	0.47	0.12	1.30	1.42
14 Transport equipment	−0.03	0.73	0.70	0.19	1.80	1.99
15 Other industrial	−0.03	0.36	0.33	0.10	1.00	1.10
16 Construction	−0.00	−0.02	−0.02	−0.00	0.01	0.01
17 Transport and communication	−0.01	0.00	−0.01	0.19	1.06	1.25
18 Government services	0.04	−0.69	−0.65	0.06	−0.52	−0.46
19 Private services	−0.00	−0.37	−0.37	0.05	−0.14	−0.09
Major exports						
10 Chemical products	−0.14	19.12	19.26	1.06	25.09	26.15
12 Mineral and metal products	−0.06	1.90	1.84	0.33	3.78	4.11
13 Machinery	−0.09	2.22	2.13	0.41	4.55	4.96
14 Transport equipment	−0.09	2.30	2.21	0.35	4.39	4.74
15 Other industrial	−0.08	3.30	3.22	0.41	5.67	6.08
17 Transport and communication	−0.29	8.24	7.95	1.54	16.97	18.51
Major imports						
1 Agricultural crops	4.32	89.19	93.51	4.24	88.81	93.05
4 Mining	−0.04	0.34	0.30	0.07	0.85	0.92
5 Crude oil	−0.04	0.07	0.03	0.08	0.63	0.71
6 Livestock products	3.30	19.25	22.55	3.04	18.09	21.13
7 Other food products	1.48	−5.95	−4.47	1.16	−8.12	−6.96
Price of land						
1 Agricultural crops	−7.41	−61.06	−68.47	−7.42	−61.07	−68.49
2 Livestock	−1.57	1.70	0.13	−1.69	1.16	−0.53
Agricultural employment						
1 Agricultural crops	−7.41	−61.06	−68.47	−7.24	−60.19	−67.43
2 Livestock	−1.57	1.70	0.13	−1.51	2.04	0.53

Table 6.2 continued

Variable	Scenario A Constant nominal wages and aggregate real domestic expenditure			Scenario B Constant aggregate employment demand and balance of trade		
	Remove subsidies	Remove border protection	Total[a]	Remove subsidies	Remove border protection	Total[a]
Real net farm income[d]						
1 Agricultural crops	−7.57	−58.01	−65.58	−7.37	−57.60	−64.97
2 Livestock	−1.73	4.75	3.02	−1.74	4.73	2.99

Note: All projections represent the percentage deviation from the level that would have been reached assuming agricultural protection remained unchanged.

[a] Since the model is linear in percentage changes the total effect is simply the sum of the separate effects of removing subsidies and border protection. Projections of the separate effects of removing subsidies and border protection are available from the author.

[b] Calculated from the expenditure side and includes terms of trade effects.

[c] Expressed as a percentage of base period GDP.

[d] Calculated as the return to land, labor, and capital employed in agriculture deflated by the consumer price index.

(Ex) Denotes variable set exogenously.

following the complete removal of agricultural protection than they would have been assuming no change in agricultural protection.

Scenario A: Constant nominal wages and real domestic expenditure. Removing farm subsidies causes unit farm production costs and domestic agricultural prices to increase. This results in a slight deterioration in international competitiveness and hence diminished international trading performance. The effects, however, are small. The results in total are dominated by the effects of removing border protection.

The immediate impact of the elimination of border protection to agriculture is a large fall in the domestic prices of competing imports of agricultural products. This encourages substitution toward the now cheaper imported product. As a result, aggregate imports are projected to increase by about 5 percent, largely as a result of a doubling in imports of agricultural crops. Imports of products classified to agricultural crops, livestock and downstream livestock products, and other food products represent about 13 percent of Japan's total imports.

Lower import prices for these products result in lower domestic prices and hence a reduction in the economy's total cost structure. This is reflected in a decline in the consumer price index of 2.9 percent and in the GDP deflator of 2 percent, the result for the former reflecting the importance of food prices in household expenditure. This enhances the international competitiveness of export-oriented sectors and to a lesser extent import-competing sectors outside agriculture. Under the assumption of fixed nominal wages, the resultant improvement in aggregate export earnings of 3.2 percent is insufficient to match the additional expenditure on agricultural imports such that the balance of trade is projected to worsen by about 0.4 percent of base period GDP. With fixed aggregate domestic spending this implies a fall in real GDP of about the same amount and a decline in aggregate labor demand of about 0.7 percent.

However, because of the decline in the consumer price index, real wages measured in terms of their purchasing power rise by 2.9 percent such that the share of national income accruing to labor increases by about 2.5 percent.

At the sector level the outcome is particularly adverse for the heavily protected agricultural crops industry. As a result of the 94 percent increase in competing imports, domestic output of agricultural crops is projected to decline by 18 percent and industry employment by 67 percent. Real net farm income in agricultural crops is projected to decline by 66 percent.

It is interesting to note that within the agricultural sector the outcome for the livestock industry is slightly favorable. While the removal of protection to livestock products results in increased imports of livestock products at the expense of output and employment in the domestic livestock product industry, the removal of protection to agricultural crops results in the domestic livestock industry paying considerably less for its livestock feed inputs. Livestock production in Japan relies heavily on purchased feed inputs. About 15 percent of the value of livestock production is represented by inputs of sector 1 (agricultural crops) and a further 43 percent by sector 7 (other food products), which in turn is heavily reliant on inputs of agricultural crops. Our results suggest that assistance provided to the livestock sector via farm subsidies and protection against the imports of livestock products more or less compensates the sector for the tax levied on it through assistance provided to agricultural crops.[13]

The results clearly demonstrate the way in which protection to domestic agriculture acts as a tax on the economic performance of Japan's export-oriented manufacturing sectors. Exports of machinery, transport equipment, other industrial, and transport and communication are projected to expand by 2.1, 2.2, 3.2, and 8.0 percent, respectively. These collectively account for 63 percent of Japanese export earnings. The expansion in exports in this part of the economy leads to enhanced ouput growth and employment prospects in Japanese manufacturing.

As a result of the elimination of agricultural protection, the price of agricultural cropping land is projected to decline by 68 percent. This would have significant ramifications for the prices of those items of Japanese consumption expenditure, such as housing and recreation, which are intensive in their use of land. The cost of providing these goods can be expected to fall appreciably if agricultural protection were removed.

In the above results the assumption of constant nominal wages is critical. With domestic prices, especially the prices paid by household consumers, projected to fall significantly as a consequence of the removal of agricultural protection, much of the gains accrue to those currently in employment through higher real wages.

Suppose, for example, that real wage stability was considered a better way of describing the functioning of the Japanese labor market over the short-to-medium term adjustment horizon. Then the removal of agricultural protection, by slowing the underlying rate of increase in domestic prices in the Japanese economy, would act to slow the rate of increase in nominal wages by the same amount. Our projections indicate the following consequences: the reduction in the consumer price index would be much larger (7.2 percent) leading to greatly enhanced international competitiveness; aggregate exports would grow by around 23 percent, significantly outweighing the increase in import penetration; there would be a net improvement in the balance of trade equivalent to about 2.2 percent of base period GDP and, with fixed real domestic expenditure assumed, an equivalent gain in real GDP and a 4 percent improvement in aggregate employment demand. At the sector level the boost to exports, output, and employment in Japan's manufacturing industries would be considerably larger. Industries supplying inputs to these activities would also gain.

Scenario B: Constant aggregate employment demand and balance of trade. Under this scenario wages in the labor market are assumed to adjust to hold employment demand constant. Similarly, real aggregate expenditure is assumed to adjust to match the economy's real aggregate income such that the outcome for the balance of trade remains unchanged.

As with scenario A, the effects of removing agricultural subsidies are minor relative to the effects of removing border protection. The overall pattern of results is also similar to that observed in scenario A. As a result of removing both subsidies and border protection, the consumer price index is projected to fall by 3.5 percent and the GDP deflator by 2.7 percent. The improvement in international competitiveness that this entails ensures sufficient growth in exports to pay for the increased imports. Aggregate foreign currency exports and imports increase by about 6 percent.

The outcomes for aggregate real domestic expenditure and real GDP are largely unchanged.[14] To maintain the total demand for labor requires a fall in nominal wages of about 1 percent. Since, however, the removal of agricultural protection is projected to reduce consumer prices, real wages, deflated by the consumer price index, rise by 2.5 percent. Hence the share of national income accruing to labor increases by the same amount.

At the sector level agricultural imports are projected to expand by 93 percent and livestock product imports by 21 percent. Imports of other food products fall somewhat, reflecting the improved competitiveness of the domestic industry through being able to obtain its agricultural inputs at considerably cheaper prices. As a result of increased import penetration, agricultural output is projected to decline by 18 percent and employment in this sector by 67 percent.

The increased agricultural imports are financed by an expansion of manufactured exports which are now considerably more competitive. Export growth of about 4 to 6 percent in the machinery, transport, and other industrial categories is projected, This leads to output gains of about 1 to 2 percent in the sectors supplying these products and employment gains of about 2 to 6 percent.

As was the case in scenario A, the major losers from the removal of agricultural protection are the owners of rural land. The rental price of agricultural land is projected to decline by 68 percent. As a result of this and the heavy exodus of labor from farming to be reemployed in manufacturing activities, real net farm income in the agricultural crops sector is projected to decline by 65 percent.

The longer term effects of agricultural protection under scenario B, assuming that capital is mobile between sectors, are broadly similar to those described above. Aggregate exports and imports are projected to expand by about 8 percent. The gain in real GDP is a little larger (0.4 percent) and the improvement in the economywide real wage is 2.4 percent.

At the sector level the contraction in agricultural crops output is larger (25 percent) as are the gains in manufacturing output. For example, output expansions of 2, 3, and 1.8 percent, respectively, are projected for the large export-oriented sectors of machinery, transport equipment, and other industrial categories. Because capital leaves agriculture the reduction in real net income of the farm sector is slightly less (58 percent).

Agricultural Protection and Japan's Aggregate Trading Performance

As noted in the first section, Japan's international trading performance over recent years has been heavily in surplus. In 1986, for example, export earnings represented about twice the expenditure on imports, a balance of trade surplus in excess of 4 percent of GNP. The results in table 6.2 under scenario A suggest that if agricultural protection were removed, assuming no adjustment of nominal wages, growth in aggregate imports of about 5 percent would occur over the short to medium term. Nearly all of this is from agricultural products and livestock products—imports of which are projected to increase by 94 and 23 percent, respectively. On its own this would reduce the trade surplus by about one-quarter to one-fifth of the current surplus of exports over imports. However, the results in table 6.2 also show that protection to domestic agriculture, as well as restraining aggregate imports, acts as a sizable tax on export performance. The removal of agricultural protection is projected to lead to an increase in aggregate foreign currency export earnings of 3 percent. If constant real rather than nominal wages are assumed, the growth in aggregate export earnings from the removal of agricultural protection would exceed the growth in aggregate import expenditure.

The clear conclusion from these results is that agricultural protection does not exert much influence on Japan's net trading performance. In fact, its removal may well enhance Japan's trade surplus. The role of agricultural protection is to influence the composition of both exports and imports. Imports are biased heavily against agricultural and livestock products and reduced as a share of GDP. Exports are also reduced as a share of GDP.

The cause of Japan's net trade imbalance is a surplus of national income over national expenditure or, alternatively, domestic savings in excess of that required to finance domestic investment. The appropriate set of policies to reduce this imbalance involves those which discourage domestic saving and hence encourage aggregate spending relative to income. There are a range of policy instruments which can achieve this. Each will have different outcomes for other aspects of macroeconomic performance and involve different relative incentives to industry growth prospects.

In table 6.3 we illustrate this by investigating the implications for the level and distribution of economic activity of a balanced increase in real domestic spending (equi-proportional changes in aggregate household consumption, private investment, and government spending). We assume that aggregate spending is raised sufficiently to cause the balance of trade to decline by 4 percent of GDP, which approximates Japan's current trade surplus. We further assume that the gains to the labor market from this increased domestic spending are taken in the form of increased employment at a constant real wage. An alternative and equally viable assumption would be that the labor market gains accrue as higher real wages to those currently in employment. Finally, we assume that the rate of protection, expressed in ad valorem terms, provided to Japanese agriculture and other sectors remains constant. That is, to the extent that the increased domestic spending worsens the competitive position of domestic agriculture, the adjustment is through increased agricultural imports rather than through an increase in the implicit rate of protection provided to agriculture by quotas holding import volumes constant.

There are a range of domestic policy instruments which could be involved to achieve the required increase in domestic spending. We do not specify a particular set.

The results indicate that a 5.6 percent increase in real domestic spending is required to wipe out a trade surplus of 4 percent of GDP. The increase in domestic spending acts to revalue the real exchange rate between Japan and the rest of the world, as seen by the 6.7 percent increase in the GDP deflator and more or less constant world prices. As a result exports become less competitive and domestic industries, including agriculture, lose market share to competing imports. The required balance of trade turn around is achieved by a 25 percent drop in aggregate export earnings and a 3.8 percent increase in aggregate expenditure on imports.[15]

The domestic contractionary effect of reduced export sales and increased import penetration is more than outweighed by the expansion in domestic expenditure, such that real GDP increases by 1.1 percent and aggregate labor demand by 1.9 percent.

At the sector level there is a reorientation of economic activity away from traded activities, especially those producing exports, to activities whose sales pattern is oriented to the domestic economy. Import-competing activities gain from the expansion in the size of the domestic market for their products

Table 6.3 Projections of the Short-to-Medium-Term Impact of a Balanced Increase in Domestic Expenditure (percent)

Variable	Balanced increase in real domestic spending of 5.58 percent
Macroeconomic	
Real GDP[a]	1.14
Real domestic expenditure	5.58(Ex)
Aggregate exports (foreign currency)	−25.05
Aggregate imports (foreign currency)	3.75
Balance of trade[b]	−4.00
Consumer price index	6.09
GDP deflator	6.68
Labor market	
Aggregate labor demand	1.93
Nominal wage	6.09
Real wage (CPI deflated)	0.00(Ex)
Labor's share of national income	6.88
Industry outputs	
1 Agricultural crops	−0.67
2 Livestock	0.31
3 Forestry, fishing	0.52
4 Mining	−0.61
5 Crude oil	−2.99
6 Livestock products	−0.14
7 Other food products	0.90
8 Textiles	3.88
9 Pulp, paper, etc.	2.76
10 Chemical products	−7.35
11 Petroleum products	−1.68
12 Mineral and metal products	−2.88
13 Machinery	−4.01
14 Transport equipment	−7.12
15 Other industrial	−2.32
16 Construction	5.29
17 Transport and communication	−4.65
18 Government services	5.07
19 Private services	2.51
Major exports	
10 Chemical products	−64.49
12 Mineral and metal products	−21.31
13 Machinery	−23.87
14 Transport equipment	−21.09
15 Other industrial	−24.55
17 Transport and communication	−86.79
Major imports	
1 Agricultural crops	9.31

Table 6.3 continued

4 Mining	– 0.84
5 Crude oil	– 0.96
6 Livestock products	15.53
7 Other food products	20.02
Price of land	
1 Agricultural crops	3.62
2 Livestock	6.50
Agricultural employment	
1 Agricultural crops	– 2.47
2 Livestock	0.41
Real net farm income[c]	
1 Agricultural crops	– 2.47
2 Livestock	0.41

Note: All projections represent the percentage deviation from the level that would have been reached in the absence of the stimulus to domestic expenditure.

[a] Calculated from expenditure side and includes terms of trade effects.

[b] Expressed as a percentage of base period GDP.

[c] Calculated as the return to land, labor, and capital employed in agriculture deflated by the consumer price index.

(Ex) Denotes variable set exogenously.

(the expansion effect), but lose from their reduced competitiveness vis-à-vis imports in obtaining domestic market share of this expanded market (the substitution effect). In the case of the major part of Japanese agriculture (incorporated within the agricultural crops sector) the income elasticity of demand is low. These activities hence benefit only a little from the 5.6 percent expansion in aggregate real household consumption expenditure. The benefits are outweighed by the reduction in competitiveness against imports. As a result imports of agricultural crops are projected to expand by 9.3 percent, resulting in a 0.7, 2.5, and 2.5 percent reduction in the sector's output, employment, and real net farm income, respectively. Imports of livestock products are also projected to expand by 16 percent and those of other food products by 20 percent, thereby reducing the demand for domestically produced livestock, which is sold as inputs to these sectors.[16]

The major gainers from the expansion in aggregate spending are those sectors which (1) face little or no competition from imports and (2) rely heavily on domestic consumption and investment for their sales. Examples are the services sectors—16 (Construction) and 18 (Government services).

The conclusion from tables 6.2 and 6.3 is that while protection of agriculture appears to have little to do with Japan's balance of trade surplus, the elimination of this surplus through balanced increases in domestic spending will retard the performance of the major part of Japanese agriculture. Put another way, the continuation by Japan of a trade surplus is beneficial to Japanese agriculture in the sense that if this surplus were eliminated, either Japanese agriculture would contract or, to prevent this contraction taking place, the rate of protection required by Japanese agriculture would need to be increased.

Notes

1. According to figures reported by Winters (1986), in 1984 only 13 percent of Japanese farms were operated by full-time labor while 71 percent of farm households received more than half their income from nonfarm sources. Average income per household member in these latter households was about 25 percent higher than in full-time farming households.

2. According to figures from the Japanese Ministry of Agriculture, Forestry, and Fisheries, Japan's food self-sufficiency has declined from 91 percent in 1960 to 76 percent in 1975 and 73 percent in 1985.

3. See in particular OECD (1987). The PSE is defined as the payment that would be required to compensate farmers for the loss of income resulting from the removal of assistance. It can be expressed either as a monetary amount or as an amount per unit of commodity produced or as the ratio of total assistance to the total value of receipts.

4. An algebraic specification of the Japan model is available on request from the Centre for International Economics.

5. Estimates from the Japan Ministry of Agriculture, Forestry, and Fisheries.

6. See Dixon et al. (1982).

7. Values assigned to the import substitution elasticities range from 1.0 for mining, 1.2 for manufacturing activities, 3.0 for agriculture, to 4.0 for processed foods. The estimates for manufacturing are drawn from the work of Shinkai (1972). Those for agriculture and processed foods are judgmental. They are higher than for manufacturing to reflect the more basic nature of the product and hence reduced scope for product differentiation between domestic and imported sources of supply.

8. The utility function is of the Klein-Rubin form. To complete the system of household demand equations requires estimates of expenditure elasticities and household budget shares for each consumption good and the Frisch parameter. Expenditure elasticities range from 0.37 (agriculture and processed foods), 1.12 (manufactured goods), to 1.39 (transport and communication). The Frisch parameter estimate for Japan is -0.64. These estimates are based on the work of Theil and Clements (1987).

9. In the case of textiles, export earnings of which represent about 14 percent of total Japanese export earnings, export volumes were assumed unable to respond to the removal of agricultural protection. This assumption is designed to reflect the

regulation of world textile trade through the international multifiber arrangement and other means. For those exports where Japan's share of the world market is small, export demand elasticities were assumed to be highly elastic (export demand elasticity of -20.0). For the major Japanese exports of machinery, metal products, transport equipment, and other industrial categories, export demand elasticities were set to -5.0. This figure is judgmental. It is designed to reflect moderate terms of trade power by Japan in these products.

10. This is the view of the labor market adopted by Ezaki (1986) in his computable general equilibrium modeling study of oil prices and fiscal and monetary policy changes in Japan.

11. The change in real aggregate expenditure is assumed to be balanced, i.e., involving equi-proportional changes in its components (aggregate household consumption expenditure, private investment expenditure, aggregate government expenditure). The composition of household consumption expenditure and private investment changes according to the theory outlined above.

12. The shocks to the power of the tariff variable (expressed in percentage changes) which correspond to the complete removal of agricultural protection are 1 (-76.19), 6 (-13.79), and 7 (-9.09). The model's zero pure-profits condition in importing is of the form $P_{2i} = eP^m{}_i\ (1+t_i)$ where P_{2i}, $P^m{}_i$, and t_i are, respectively, the local price of imported good i, the cif foreign currency import price of good i, and the tariff equivalent of all border protection on good i. The power of the tariff on i is given by $1+t_i$. e represents the nominal exchange rate (yen/unit of foreign currency).

Consider for example $i=1$ (agricultural crops). From table 6.1 $P_{2i}/P^m{}_i = 420$ percent. Hence $t=3.2$ or 320 percent. For complete removal of t the required percentage change in $1+t_i$ and hence the percentage change in P_{2i} is $-100\ (t_i/1+t_i) = -76.19$ per cent.

13. This result may in part follow from the lack of a detailed disaggregation of imputs to agriculture and livestock. In particular, livestock feed inputs are classified in the Japanese input-output tables as being part of agricultural crops and part of other food products. Hence, in the model they incur the same level of protection as the average for the sector in which they are classified. In reality some livestock feed inputs are not subject to border protection.

14. That is, according to the model the aggregate welfare gains, in terms of the addition to aggregate real income, from the removal of agricultural protection are small over the short to medium term. The pure efficiency gains are somewhat larger, being offset by terms of trade losses because of the assumed less than perfect elasticity of world demand for Japan's major exports. World prices for Japan's major exports are projected to decline by around 1 percent.

It is well known, however, that comparative-static general equilibrium models of this type capture only the allocative gains from assistance reform. They do not provide a treatment of the major source of welfare gains—the so-called dynamic gains.

15. The weights in the model's balance of trade equation refer to 1980, in which Japan's net trade was close to zero. The aggregate responses, especially with respect to exports and imports, would differ somewhat if 1988 balance of trade weights were

used, though the broad pattern of results would remain unchanged.

16. According to the Japanese input-output tables, the livestock sector makes small sales to industry 8 (textiles), industry 19 (private services), and to investment. The size of each of these markets is projected to expand. This is sufficient to compensate the sector for the reduced sales opportunities available to it from the downstream livestock product and food product sectors such that the output of livestock expands slightly.

References

Bale, M. D., and E. Lutz. 1981. Price restrictions in agriculture and their effects: An international comparison. *American Journal of Agricultural Economics* 63(1):8–22.

Dicke, H., J. B. Donges, E. Gerken, and G. Kirkpatrick. 1989. The economic effects of agricultural trade liberalization in Germany. Chapter 4 of this volume.

Dixon, P. B., B. R. Parmenter, J. Sutton, and D. P. Vincent. 1982. *ORANI: A multisectoral model of the Australian economy.* Amsterdam: North-Holland Publishing Co.

Ezaki, M. 1986. A computable general equilibrium model of the Japanese economy. *Kobe Economic and Business Review,* no. 32.

Hayami, Y. 1987. Japanese agriculture under siege. Tokyo (unpublished).

OECD. 1987. *National policies and agricultural trade.* Paris.

O'Mara, P., P. Knopke, and I. Roberts. 1981. Costs of Japanese agricultural support policies: Some concepts and estimates. *Quarterly Review of the Rural Economy* 3(2):141–148.

Shinkai, Y. 1972. Elasticities of substitution for the Japanese imports. *Review of Economics and Statistics* 54(2):198–202.

Theil, H., and K. Clements. 1987. *Applied demand analysis: Results from system-wide approaches.* Cambridge, Mass.: Ballinger.

Tyers, R., and K. Anderson. 1986. Distortions in world food markets: A quantitative assessment. Background paper for the World Bank's *World development report 1986.* National Centre for Development Studies, Australian National University.

Vincent, D. P. 1989. Domestic effects of agricultural protection in Asian countries with special reference to Korea. Chapter 5 of this volume.

Walker, A. 1988. World agricultural trade distortions—Measurement and recent trends. Paper presented at the Conference of the Australian Agricultural Economics Society, February, Melbourne.

Winters, L. A. 1987. The economic consequences of agricultural support. OECD Economic Studies no. 9 (Autumn): 7–54.

7. Agricultural Policies and the U.S. Federal Budget and U.S. Trade Deficit

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Andrew Feltenstein

Summary

This study analyzes the effects of agricultural policies, in particular spending on subsidies, on the macroeconomy in the United States. Subsidies have not only direct budgetary implications, in that they represent government expenditures, but they also distort the relative price structure and thereby the allocation of scarce factors. In addition, a reduction in subsidies will, via its impact on domestic interest and inflation rates, affect private savings and investment in ways that can result in major changes in both real income and the trade balance.

Four types of agricultural subsidies are examined: subsidies on the inputs of value added to production, trigger price mechanisms in which the government guarantees a fixed price for agricultural output, consumption support to consumers, and payment for land set-asides, i.e., payment to farmers in return for withdrawing land from production. All of these subsidies have both direct and indirect implications. Import subsidies and guaranteed minimum prices tend to expand U.S. output, all other things being equal. Consumption supports, on the other hand, tend to increase domestic output and consumption but decrease exports. Finally, set-asides result in not only an increase in government spending, but also a reduction in acreage. The relative rental price of land increases, as does the price of agricultural output, thereby negatively affecting U.S. farm exports.

The analysis uses the framework of a general equilibrium model with

forward-looking agents.[1] It is essential to use a general equilibrium framework, since a partial equilibrium approach ignores most of the important macroeconomic interactions. The simple macroeconomics of a reduction in subsidies may be thought of as follows. The initial impact of the reduction is to reduce the government's budget deficit, thereby decreasing the rate of monetary expansion and raising the real interest rate. This outcome depends on the formulation of government financing assumed in the model, in which the sale of bonds is fixed and monetization is derived as a residual. In response to the higher real rate, consumers increase their savings, while the rate of private investment declines. Accordingly, overall domestic savings increases, leading to an initial improvement in the trade balance. At the same time, the reduction in subsidies, in particular of set-asides, causes the export price index, in which agriculture is an important component, to decline. Thus foreign export demand increases. (These conclusions are subject to a number of conditions, in particular that export supply is elastic, which seems justified by empirical studies.) At the same time, however, the improved trade balance brings about a strengthening of the U.S. dollar, causing imports to increase and the final improvement in the trade balance to be less than observed initially.

After giving the model parameters that reasonably well replicate the macroeconomic events of 1985–86, an experiment is conducted in which we ask what the results would have been if all agricultural subsidies had been removed in those years. It is determined that the removal of subsidies, which would have resulted in a direct budgetary saving of $58 billion over the two years, would have actually saved a total of $74 billion through its impact on interest rates and the tax base. Thus the currently sought after $30 billion could be more than achieved by reducing or eliminating agricultural subsidies.

The trade balance also improves by more than the reduction in subsidies. The elimination of the $31 billion in subsidies would have brought about an estimated improvement in the trade balance of approximately $42 billion in 1986. This improvement stems from the impact of an increase in the real interest rate on domestic savings and investment, as well as a relative decline in the export price index. Key nominal variables also improve sharply under the counterfactual simulation. Both the nominal interest rate and the inflation rate decline significantly, although the real interest rate increases. The rate of decline in the U.S. dollar exchange rate slows, so that in 1986 the nominal value of the dollar would have been about 18 percent higher than with the original level of subsidies. In addition, the real value of the dollar would have been about 5.5 percent higher than before.

A qualified conclusion may thus be drawn that a reduction, or perhaps elimination, of agricultural subsidies would significantly reduce the current budgetary and trade imbalances. In particular, an elimination of subsidies would bring about an almost 30 percent improvement in the trade balance, and would go far toward lessening pressure on the dollar. These results may, indeed, be overly conservative, since any efficiency gains due to reductions in subsidies have not been incorporated. Other studies indicate that there would be substantial efficiency gains, which, if incorporated into the analysis, would yield even greater improvements in trade, budget, and price variables.

Introduction

The objective of this study is the analysis of the effects of agricultural policies on the U.S. macroeconomy. Limited resources prevented the examination of all aspects of agricultural policy, so we concentrated on the role of subsidies—major items of government expenditure which are often highly controversial. Subsidies are examined in the context of an intertemporal general equilibrium model, since partial equilibrium analysis has been found to ignore important macroeconomic effects. Subsidies not only have direct budgetary implications, in that they involve government expenditure, but also distort the relative price structure and thereby the allocation of scarce factors, in particular, land. In addition, a reduction in subsidies will, via its impact on domestic interest rates, affect private savings and investment in ways that can, as will be seen, cause significant changes in both real income and the trade balance.

Four types of subsidies present at least to some extent in the United States are examined. The first of these is a simple percentage subsidy on the inputs of value added, in this case land, to agricultural output. The second type of subsidy is based on a trigger price. If the price of a particular agricultural item falls below some predetermined fixed price, then the difference between the fixed price and the market price is paid as a direct subsidy to the producers of the product. The third type of subsidy is not realized as a direct payment, but rather is a support that prevents the price paid by consumers from rising above some specified fixed price. Thus if the market price of an agricultural product rises above some fixed price, consumers pay only that price and the government subsidizes the difference as a payment to producers, who receive the market price. The final subsidy is a payment to farmers not to produce. This is represented by payments made for farmland that is set aside from production. Thus, the government contracts with farmers to take a certain amount of land out of production, and then pays the farmers the market price for the land. Thus, the supply of land falls, tending to drive up the market price of land while at the same time reducing the tax base.

Many studies have attempted to analyze the interaction between general fiscal policies and macroeconomic outcomes in the United States. Possibly the most relevant, from the point of view of this study, is the recent book by Marris (1985). Marris makes a strong connection between the rising structural budget deficit in the United States and the increase in investment demand, leading to capital inflows and the rise of the dollar that occurred from 1980 to 1985. The study then, quite remarkably in view of the fact that it was written in 1985, fairly accurately predicts the later collapse of the dollar and the massive U.S. trade deficit. These predictions are based on an underlying model which asserts that the trade deficits, brought about by U.S. budget imbalances, will cause a massive devaluation of the dollar as U.S. foreign debt becomes intolerably large.

The model underlying the Marris study has certain characteristics which, though typical of macroeconomic studies, reduce its usefulness for our study.[2] Production is fully aggregated, so it is not possible to consider sector-specific policies such as agricultural subsidies. The domestic interest rate, one of our primary concerns, is not determined within the model, but is set externally, as are U.S. GNP growth rates and changes in exchange rates. There is also no direct way to incorporate disaggregated fiscal policies, since only the structural budget deficit enters into the calculations. Possibly most important, because the model is essentially static there is no endogenous determination of domestic savings based on current interest rates and the price and income expectations of forward-looking consumers. As will be seen, the lack of endogenous savings determination can cause serious underestimation of the impact of public spending cuts on the trade balance. In particular, it would not be possible to arrive at the eventual conclusion that an elimination of the $31 billion currently spent on agricultural supports could lead to a reduction of about $42 billion in the overall U.S. trade deficit.

Policy Issues

The key policy question that this study considers is straightforward: What would be the macroeconomic implications of a reduction in agricultural subsidies? More particularly, how would a cut in subsidies affect, first, the overall budget deficit, and, second, the trade balance? Clearly these two issues are connected since a large budget deficit that leads to an excess of demand for domestic investment over domestic savings will cause a trade imbalance. What is not clear is the magnitude of the numbers involved. Suppose, as an extreme example, that agricultural subsidies were completely eliminated. Would there be a net reduction of $31 billion in the budget deficit, or is it possible that there would be significant efficiency gains for agriculture, and possibly for the rest of the economy, so that the tax base would increase and the net reduction in the deficit would be greater than $31 billion? Is it also possible that the reductions might lead to a decrease in the excess demand for domestic investment, causing the trade balance to improve by more than the subsidy cuts? In short, can the country expect to get "more bang for its buck"?

To have a more concrete understanding of how these issues are answered here, it may be useful to outline briefly the macroeconomic workings of the model. (The manner in which general equilibrium modeling techniques enter the analysis is discussed below.) A start might be made with a simple macroeconomic accounting identity:

$$(S-I)+(T-G)=X-M \tag{1}$$

where S represents domestic private savings, I domestic private investment, T federal tax revenues, G federal spending, X exports, and M imports.

Assume that the government reduces agricultural subsidies. The initial impact is that G declines. Thus the federal deficit, $D=G-T$, also declines.[3] If, for simplicity, foreign financing and domestic bond sales are taken as fixed, then this means that the rate of growth in the money supply will also decline. Hence the real interest rate will tend to rise and the rate of inflation will decline. In the face of a rising real interest rate, the forward-looking consumer, seeing that he is getting a relatively better deal on future consumption, will increase his savings. At the same time investors, who equate the current cost of borrowing to the anticipated future return on capital, will tend to reduce their investment, since financing has become more expensive. Although the initial impact of the subsidy cuts may also be to reduce savings, perhaps by as much as the total reduction, since part of the subsidies are paid as income supports to farmers, this decrease in income affects relatively few consumers. Increased real interest rates affect all consumers, however, and, at least given the parameters of our study, the overall effect is to raise private savings. Thus S – I rises so that the current account, X – M, rises more than the simple change in G – T. Thus the improvement in the trade balance may be considerably greater than the improvement in the budget deficit. Also, since inflation declines, there may be a positive terms of trade effect, causing X and S simultaneously to increase further.[4]

A general equilibrium approach must be used to determine simultaneously the interaction of the consumer, determining S, the investor, determining I, and the subsidy cuts, determining G and T. Since the United States is a large country, these are equated, via price and exchange rate adjustments, with the outcomes of export and import equations. It is precisely this type of simultaneous solution that is missing from the type of work represented by the Marris study.

Agricultural Support Policies and the U.S. Macroeconomy

Some Background Information

Just how significant are agricultural spending policies, in particular on price supports, in the overall U.S. budgetary picture? Some recent statements by Prime Minister Margaret Thatcher of Great Britain are relevant. She is reported to have said that in Iowa, farmers this year will receive more loans and other aid from Washington than all the nations of Africa get from the World Bank.[5] As a matter of fact, the amount of money spent on agricultural support programs in the United States represents a major portion of the federal budget deficit.

Table 7.1 gives total revenues and expenditures of the U.S. federal government over the period 1979–86. The well-known increase in the deficit, which grew from $40 billion in 1979 to $220 billion in 1986, should be noted. If the partial breakdown of expenditures is examined, it can be seen that agriculture represents the largest single item in current expenditures after defense, health, social security, and interest payments on outstanding debt. Of these four larger types of outlays, social security and interest payments represent essentially prior commitments and are thus less susceptible to immediate budgetary action than are other expenditure items. It is interesting to note that of the remaining items, health expenditures grew by 80 percent between 1979 and 1986, while expenditures on agriculture grew by 182 percent—even more than the 135 percent increase in defense spending. The amount spent on agricultural support programs thus represents a major portion of the overall budget deficits.

Between 1981 and 1985 the federal government spent about $60 billion on farm price and income support programs. The original estimate for farm program outlays for 1986 was significantly below the actual cost of $25.9 billion associated with Commodity Credit Corporation (CCC) activities to support the agricultural sector. Other related programs also support agricultural production and rural America; in 1986 the outlays for these programs amounted to approximately $4 billion. The largest single item was Farmers Home Administration outlays at $8 billion (U.S. Government Printing Office 1987, 155).

Thus, merely the costs associated with support of the CCC represent almost 12 percent of the budget deficit of $220 billion in 1986. Just how was this money spent? Corresponding to the first type of subsidy, in which ad valorem payments are made to agricultural producers, an export enhancement scheme helps to finance U.S. agricultural sales abroad by providing both export guarantees as well as direct price subsidies. A deficiency payment system, in which producers receive payments for the difference between the market price and a target price, corresponds to the second type of subsidy. In 1986 more than $20 billion was spent on food assistance programs, in which an implicit lump sum payment is made to certain consumers to finance their consumption of agricultural products at below market prices. This corresponds to the third type of subsidy in which the price paid by consumers is subsidized if the market price rises above some predetermined target price. Finally, the 1985 Food Security Act aims to manage agricultural output by inducing farmers to accept reductions in the total acreage that they plant, thus raising prices and reducing the need for deficiency payments. These set-asides correspond to the fourth kind of subsidy.

A general relationship between growth in the budget deficit and increase in the trade deficit can be deduced from table 7.1 and figure 7.1. Figure 7.1 illustrates these variables as well as indicates the behavior of personal savings and gross private investment over the period 1979 to 1986. Thus general historical support is garnered for the model's projections. A rapid increase in government spending, combined with reduced growth in revenues, caused the budget deficit to soar. At the same time, stagnant behavior of personal

Table 7.1 U.S. Macroeconomic Indicators and Agricultural Supports (in billions of dollars)

	1979	1980	1981	1982	1983	1984	1985	1986
Federal revenues	463	517	599	618	601	666	734	769
Federal expenditures	503	591	678	746	808	852	946	990
Agriculture	11	9	11	16	23	14	26	31
Defense	116	134	158	185	210	227	253	273
Transportation	18	21	23	21	21	24	26	28
Education and social services	30	32	34	27	27	28	29	30
Health	20	23	27	27	29	30	34	36
Social security	104	119	140	156	171	178	189	199
Veterans administration	20	21	23	24	25	26	26	26
Interest payments	43	53	69	85	90	111	129	136
Other	141	179	193	205	212	214	234	231
Federal deficit	−40	−74	−79	−128	−207	−186	−212	−221
Exports	184	224	237	211	201	219	214	219
Imports	212	250	265	248	269	332	339	370
Merchandise trade deficit	−28	−26	−28	−37	−68	−113	−125	−151
Personal savings	118	137	159	154	131	169	143	116
Gross private domestic investment	455	437	516	447	502	662	661	686

Source: U.S. Government Printing Office, *Economic report of the president* (1987); International Monetary Fund, *International financial statistics* (1987).

savings worked with rapid increases in investment demand to bring about rising trade deficits ($28 billion to $151 billion over the period). In the next section we indicate how a general equilibrium framework links all of these elements analytically.

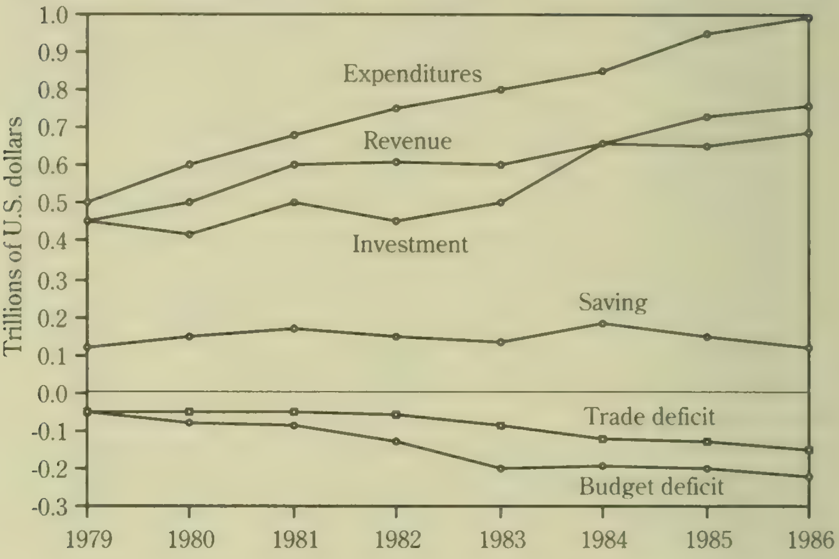
Overview of the Model

In this section the general equilibrium structure of the study is outlined, and some underlying empirical parameters are indicated. The functional forms of the structural equations are given in appendix A.[6]

Production

An input-output matrix is used to determine intermediate and final production. Because the model incorporates perfect foresight in both production

Figure 7.1 U.S. Macroeconomic Indicators



and consumption, this matrix may be thought of as being replicated in each of two years. Corresponding to each sector in the input-output matrix, value added is produced using capital, land, and labor. The technology that produces this value added is sector-specific so that, for example, agriculture would have a higher relative share of land in value added than would chemicals.

We suppose, for simplicity, that there is a single type of capital, which is produced via an investment technology that uses inputs of capital and labor to produce new capital. The investment is carried out by the private sector, and since the capital that is produced in one period becomes available only in the next period, the investment firm must pay for the input costs of its production in the current period, but will receive the revenue from that capital in the next period. Suppose, then, that the rental price of capital in period i + 1 is $P_{K(i+1)}$. If C_{Hi} is the cost-minimizing cost of producing the quantity of capital, H_i, then future debt obligations must be equal to the return on new capital. Hence

$$C_{Hi} = P_{K(i+1)}\frac{H_i}{1 + r_i} \qquad (2)$$

where $r_i = P_{Mi}/P_{Bi}$ is the interest rate in period i. Hence the level of private investment depends on both the current interest rate and the perfectly anticipated future return on capital. Thus government policies that affect interest rates, such as cutting spending, will have an immediate impact on private investment.

All sectors in the economy pay both income and profit taxes, while agriculture may receive a subsidy on its use of land. Along with its spending on agricultural subsidies, transfer payments, and interest obligations, to be discussed shortly, the government produces public goods using capital and labor as inputs to production. The government's target for output of public goods is determined exogenously in terms of constant dollars. An attempt to model an optimizing government thus is not made.

Consumption

A single generation of consumers is assumed for the entire period of the model. The consumers have perfect foresight, and hence perfectly anticipate all prices of period 2 while in period 1. The individual consumer maximizes a utility function, U, which has as arguments the levels of consumption and leisure in each of the two periods.[7]

The consumer maximizes his utility function, subject to a set of intertemporal budget constraints. He has initial allocations of money—domestic and foreign bonds, M_0, B_0, and B_{F0} respectively—at the beginning of period 1, and, if he is a shareholder in the capital goods-producing firm, he will also hold capital, K_0, while he may also hold land, A_0. Let P_{Ki}, P_{Ai}, P_{Li}, P_{Mi}, P_{Bi}, e_i represent the price of capital, land, labor, money, domestic bonds, and the exchange rate, respectively, in period i, and let TR_i represent whatever transfer payments the government pays to this consumer during period i.[8]

Bonds are considered to be long term, so that a consumer owning a bond receives its par value, assumed to be \$1, as an interest payment in each period. Since this payment is made in units of money, his income from the bond in period 1 is 1, while in period 2 it is P_{M2}. He also has the possibility of selling the bond at market prices P_{Bi}. The consumer's income, or, to be more precise, his purchasing power, in period 1 is then given by

$$I_1(P_1) = P_{K1}K_0 + P_{A1}A_0 + P_{L1}L_0 + M_0 + B_0 + P_{B1}B_0 + \\ e_1\,(1 + r_{F1})\,B_{F0} + TR_1. \tag{3}$$

The consumer's income in period 2, $1_2(P_2)$, becomes

$$I_2(P_2) = P_{K2}(1-\delta)K_0 + P_{A2}A_0 + P_{L2}L_0 + P_{M2}X_{M1} + P_{M2}X_{B1} + P_{B2}X_{B1} + e_2(1+r_{F2})X_{BF1} + TR_2 \tag{4}$$

where X_{M1} is the nominal quantity of money that the consumer holds in period 1, X_{B1} is the quantity of domestic bonds he purchases, X_{BF1} is the quantity of foreign bonds he buys, and r_{Fi} is the foreign interest rate in period i. Thus if $P_{B2} > P_{B1}$, the consumer realizes a capital gain on his purchase of domestic bonds in period 1, while if $e_2 > e_i$, i.e., the exchange rate depreciates, raising the domestic currency value of foreign bonds, then he realizes a capital gain on foreign bonds. Thus government policies that affect either the domestic interest rate or the exchange rate will have an immediate impact on the consumer.

The consumer pays market prices for all goods except agriculture, which, for some consumers, is subsidized.[9] Personal income taxes are not paid directly by the consumer, but are withheld at the enterprise level, where profit taxes are also collected. The consumer has a demand for money represented by a functional form, uniform across all consumers, in which demand for nominal cash balances depends on the value of current consumption and the nominal interest rate. This demand may thus be interpreted as a cash-in-advance constraint in which the velocity of money is interest sensitive. An increase in the nominal interest rate then lowers the demand for money, tending to raise the rate of inflation.

The total value of the consumer's consumption each period must be equal to or less than the corresponding income, hence

$$P_iX_i + P_{Li}X_{Li} + P_{Bi}X_{Bi} + e_iX_{BFi} + P_{Mi}X_{Mi} \leqslant I(P_i). \tag{5}$$

P_i represents the set of sectoral prices in period i. In order to close the model, some assumption must be made about consumers' holding of debt in period 2.[10] Accordingly, it will be supposed that demand for bonds in period 2 is determined by the long-run savings rate of the economy, assumed to be constant. Finally, it is assumed that the consumer allocates savings between domestic and foreign bonds according to relative rates of return, evaluated in terms of domestic currency. Thus savings rates are endogenously determined by intertemporal maximization in period 1, but are fixed in period 2.

Financing the Central Government

The government collects income and profit taxes as well as import duties, and pays the subsidies described above. In addition, the government must cover both domestic and foreign interest obligations on public debt. The deficit of the central government in period 1, D_1, is then given by

$$D_1 = G_1 + S_1 + B_0 + e_1 r_{F1} B_{F0} - T_1 \qquad (6)$$

where S_1 represents subsidies given to agriculture in period 1, G_1 is spending on goods and services, while the other two terms reflect domestic and foreign interest obligations of the government. Thus, for example, policies that cause the exchange rate to depreciate will increase foreign interest payments. T_1 represents total revenues of the government.

The resulting deficit is financed by a combination of monetization and domestic and foreign borrowing. Then if Y_{BG1} represents the face value of domestic bonds sold by the government in period 1, and C_{F1} represents its foreign borrowing, then its budget deficit in period 2 is given by

$$D_2 = G_2 + S_2 + P_{M2}(Y_{BG1} + B_0) + e_2 r_{F2}(C_{F1} + B_{F0}) - T_1 \qquad (7)$$

where S_2 represents agricultural subsidies in period 2, P_{M2} $(Y_{BG1} + B_0)$ is the interest obligations on outstanding debt plus domestic borrowing from period 1, and $e_2 r_{F2}$ $(C_{F1} + B_0)$ is the interest payment on foreign debt plus period 1 foreign borrowing.[11]

The Foreign Sector

The foreign sector is represented by a simple export equation in which aggregate demand for exports is determined by relative domestic and foreign price indices as well as world income. Hence exports are sensitive to changes in the exchange rate as well as to domestic price changes. The combination of the export equation and domestic supply responses then determines aggregate exports. Capital flows are derived from the domestic consumers' portfolio balance equation, in which relative shares of domestic and foreign bonds are determined by relative current interest rates, deflated by anticipated changes in the exchange rate. Foreign lending has not been modeled but has been taken to be exogenous. Thus gross capital inflows are exogenous, but net capital flows are determined endogenously by the savings behavior of domestic consumers.

Application of the Model to the United States

In this section some of the basic empirical methodology used is described. The extent to which actual U.S. outcomes for 1985–86 have been replicated will be indicated. This replication is important if there is to be any confidence in the predictions of the counterfactual simulations.

Intermediate and final production is taken from an eighty by eighty (sector) input-output matrix representing 1983, which is condensed to ten by ten, corresponding to the aggregate production sectors of the U.S. national accounts.[12] These sectors are

1. Agriculture
2. Mining
3. Construction
4. Manufactures
5. Transportation and utilities
6. Domestic trade
7. Finance
8. Services
9. Government
10. Imports

The Armington (1969) assumption is made that goods are distinguished by type as well as by place of origin. Hence imports are a separate row in the input-output matrix.

The derivation of sectoral production functions is given in the appendix. Profit and labor tax rates have been taken to be the average effective rates across the economy for 1985–86, so that at this stage no attempt has been made to derive rates on a sector-by-sector basis. Spending by the government is taken to have its actual values for 1985–86, while the shares of capital and labor in government production were derived from the wage bill of the public sector. Factor shares in the construction industry were used to represent the corresponding shares in private investment. All initial allocations of factors and financial assets were given their end-of-1984 values. Thus, for example, a unit of land is that amount of land which earned $1.00 in 1984, while the money supply is given by the end of 1984 value of M1.

There are essentially two sets of behavior parameters to be estimated. The first of these relate aggregate money real demand to interest rates and real income. Here the estimates of Wenninger and Sivesind (1979) are used. The long-run form of this equation is

$$\text{Log } M/P = -0.426 \text{ Log } r + 0.99 \text{ Log } y$$

where r is the interest rate and y is real income.

In order to generate aggregate demand for U.S. exports, export elasticities reported in Stern et al. (1976) are used. The annual relative price elasticity of exports is −1.24, while the elasticity of world income is 0.77.[13] The value shares of each of the nine domestic sectors is fixed and is given by their relative shares in 1984. Finally, the model has been taken to have three consumers. The first two of these are domestic and consumer 1 represents the non-land-owning consumer who owns capital, while consumer 2 owns the stock of land but does not own capital. The third consumer is the rest of the world, and is thus represented by the export demand equation.

An initial simulation intended to test the accuracy of the model in replicating true U.S. outcomes in 1985–86 was carried out; agricultural price supports and set-asides were given their true values. The equilibrium outcomes for the two periods are given in table 7.2. The actual figures for the U.S. are in parenthesis. Thus it can be seen that the model generates outcomes which are reasonably close to the actual results for the United States, the only significant inaccuracies being in the inflation rate and the 1985 interest rate. It thus seems plausible to use these parameters as the basis of counterfactual simulations.

The Macroeconomic Effects of Elimination of Agricultural Supports

A simple, if extreme, exercise follows. It is supposed that the government totally eliminates all agricultural price subsidies and, in addition, no longer pays for land set-asides. Columns 2 and 4 of table 7.3 are the same as columns 1 and 3 of table 7.2; that is, they are the results of the simulation using historical parameters. Table 7.3 thus reports the outcome of the simulation involving elimination of price subsidies, with results being given in columns 1 and 3.

The budget deficit declines by 1.0 percent of GDP in 1985 and 0.8 percent in 1986, even though the direct reduction in spending on agricultural subsidies was only 0.6 percent of GDP in both years. The general reason for this

Table 7.2 Base Simulation for 1985–86: Historical Agricultural Subsidies

	1985		1986	
	(1)	(2)	(3)	(4)
Real GNP[a]	3585.0	(3585.0)	3625.0	(3677.0)
Change in real GNP[b]	—	(2.8)	1.1	(2.6)
Government spending: G[c]	22.5	(23.7)	23.0	(23.5)
Tax revenues: T[c]	18.4	(18.4)	18.2	(18.3)
Government budget deficit: D[c]	4.1	(5.3)	4.8	(5.2)
Agricultural subsidies: S[cd]	0.6	(0.6)	0.6	(0.7)
Private investment: I[ce]	8.7	(8.6)	8.7	(8.7)
Exports: X[c]	9.4	(9.1)	10.1	(8.8)
Imports: M[c]	9.5	(11.8)	10.3	(12.4)
Trade balance: TB[c]	−0.1	(−2.7)	−0.2	(−3.6)
Inflation rate: Π[bf]	—	(3.3)	10.5	(2.6)
Price level: P[i]	100.0	(100.0)	110.5	(102.6)
Interest rate: r[fg]	15.5	(7.5)	8.4	(6.0)
Change in exchange rate: e[bfh]	—	(3.5)	−20.6	(−21.8)
Exchange rate: e[i]	100.0	(100.0)	79.4	(78.2)

Note: Columns 2 and 4 report actual outcomes for 1985 and 1986, while Columns 1 and 3 report simulation results.

[a] In billions of 1982 dollars.

[b] The percentage changes in the first year cannot be calculated.

[c] As percent of GNP.

[d] The simulated figures (Columns 1 and 3) incorporate payments made for price subsidies and for land set-asides.

[e] The model treats investment as being expenditure on producers' durable equipment and treats expenditure on structures as being current expenditure. Hence the figures in Columns 2 and 4 reflect actual investment spending on producers' durable equipment rather than total fixed investment.

[f] In percent.

[g] The 3-year U.S. Treasury bill rate is used for the actual figure.

[h] The multilateral trade-weighted value of the U.S. dollar is used to calculate the actual U.S. exchange rate. The exchange rate is in terms of units of foreign currency per U.S.$.

[i] An index number based on 1985.

difference comes from several sources. First, the nominal interest rate drops significantly when subsidies are eliminated, thereby reducing the value of domestic debt servicing. At the same time, although not reported in table 7.3, the nominal wage rate declines by less in both periods than does the overall price level, causing the supply of labor to increase; this leads to an increase in income tax revenues.

It should also be noted that the real interest rate in 1986, which was negative in the base simulation, has now become positive as the reduction in the budget deficit has cut the rate of monetary expansion. Accordingly, private investment has declined, as in the model description earlier in this

Table 7.3 Counterfactual Simulation for 1985–86: Agricultural Subsidies Eliminated

	1985		1986	
	(1)	(2)	(3)	(4)
Real GNP[a]	3596.0	(3585.0)	3653.0	(3625.0)
Change in real GNP[b]	—	—	1.6	(1.1)
Government spending: G[c]	21.7	(22.5)	22.3	(23.0)
Tax revenues: T[c]	18.6	(18.4)	18.3	(18.2)
Government budget deficit: D[c]	3.1	(4.1)	4.0	(4.8)
Agricultural subsidies: S[cd]	0.0	(0.6)	0.0	(0.6)
Private investment: I[ce]	8.5	(8.7)	8.4	(8.7)
Exports: X[c]	9.4	(9.4)	10.5	(10.1)
Imports: M[c]	9.5	(9.5)	9.9	(10.3)
Trade balance: TB[c]	−0.1	(−0.1)	0.6	(−0.2)
Inflation rate: II[bf]	—	—	4.6	(10.5)
Price level: P[i]	93.7	(100.0)	98.8	(110.5)
Interest rate: r[fg]	11.8	(15.5)	5.5	(8.4)
Change in exchange rate: e[bfh]	—	—	14.0	(−20.6)
Exchange rate: e[hi]	106.5	(100.0)	93.8	(79.4)

Note: All footnote letters of table 7.2 apply here also. The figures in parentheses are the outcomes of the base case, i.e., columns 1 and 3 of table 7.2.

chapter. Private savings also increase, although not shown here, as consumers have a Fisherian response to the higher real rate. As a result there is an overall improvement in the trade balance of 0.8 percent of GDP in 1986, as compared with the base case. This improvement is generated by an increase in exports, which is itself a product of a decline in the foreign currency value of the export price index. It is partly negated, however, by an increase in the volume of imports caused by the strengthened dollar.

Conclusions

The results of the simulated elimination of agricultural subsidies tend to support the intuitive macro outcomes described earlier. An elimination of the supports and set-aside payments, equal to about 0.6 percent of GNP in replication of 1985 and 1986, leads to improvements of 1.0 percent of GNP in the budget deficit in 1985 and 0.8 percent in 1986. In 1985 this would have been equivalent to approximately $40 billion while in 1986 it would have been $34 billion. Accordingly, a total reduction of agricultural subsidies of $58 billion over the two years would have saved $74 billion in accumulated budget deficits. Thus the currently sought after $30 billion in deficit reductions could be more than achieved by eliminating agricultural supports.

The trade balance also improves by more than the reduction in agricultural subsidies. It is estimated that the elimination of the $31 billion in subsidies in 1986 would bring about an improvement of approximately $42 billion (i.e., 0.2 percent of GNP more than the subsidy reduction) in the trade balance. This improvement stems from the impact of an increase in the real interest rate on domestic savings and investment, as well as a relative decline in the export price index, due to the overall lower rate of inflation and, in particular, the sharp decline in the price of agricultural exports. Eliminating land set-aside payments lowers the price of agriculture by approximately 27 percent in 1985, with respect to the base case, and by almost 28 percent in 1986. Thus, overall, domestic savings increases and investment declines, while public savings also increases, leading to an increase in the trade balance, which, in turn, corresponds to the increase in the aggregate foreign demand for exports.

Key nominal variables also improve sharply under the counterfactual simulation. Both the nominal interest rate and the inflation rate decline significantly, although the real interest rate increases. The rate of decline in the U.S. dollar exchange rate slows, and the real exchange rate index improves by about 5.5 percent.[14] Accordingly, it seems that an elimination, or perhaps more realistically a reduction, of agricultural support spending would achieve "more bang for the buck."

There are several caveats to be made. Relatively little direct estimation has been done, but most of the parameters have been taken from literature surveys. Accordingly, an argument could be made that these parameters do not accurately reflect present day reality. Forward-looking domestic consumers have been modeled; they derive their consumption and savings on the basis of current and future prices and interest rates, which in turn determine anticipated capital gains, cost of consumption, and so forth. A similar foreign consumer has not been modeled so that, in particular, gross capital inflows are exogenous, although the net capital flows are endogenous, determined by the behavior of domestic consumers and the financing policies of the government. Clearly, a more elaborate model would include endogenous foreign financial behavior, given the role of the United States in world financial markets.

Despite these and other qualifications, the results are probably quite conservative and the actual trade and budgetary improvements would be greater than reported here. No efficiency gain in agricultural production as a result of the subsidy removals has been assumed. Many other studies have indicated that there would be substantial efficiency gains both in agriculture and in other parts of the economy as an outcome of subsidy reductions. If these gains were to be incorporated endogenously into the model, the counterfactual simulation would predict yet larger improvements in the endogenous trade, budget, and price variables.

Appendix

Model Formulation

The consumer's maximization problem is given by max x_1d1 x_2d2 . . . x_{2N}d2N x_{L1}dL1 x_{L2}dL2 such that

$$\begin{aligned}&P_1X_1+P_{L1}X_{L1}+P_{B1}X_{B1}+e_1X_{BF1}+X_{M1}\leqslant +P_{K1}K_0+P_{A1}A_0\\&+P_{L1}L_0+M_0+B_0+P_{B1}B_0+e_1(1+r_{f1})B_{F0}+TR_1\end{aligned}\tag{1}$$

$$\begin{aligned}&P_2X_2+P_{L2}X_{L2}+P_{A2}A_0+P_{B2}X_{B2}+P_{M2}X_{M2}\leqslant P_{K2}(1-d)K_0\\&+P_{A2}A_0+P_{L2}L_0+P_{M2}X_{M1}+P_{M2}X_{B1}+P_{B2}X_{B1}+e_2(1+r_{F2})X_{BF1}\\&+TR_2\end{aligned}\tag{2}$$

$$P_{B2}X_{B2}=(1+t_2)P_2X_2/z\tag{3}$$

$$\frac{P_{Bi}X_{Bi}}{P_{Fi}X_{BFi}}=c\left\{\frac{\dfrac{1+r_i}{e_{i+1}(1+r_{Fi})}}{e_i}\right\}^{d}\qquad c,d\geqslant 0\tag{4}$$

$$P_{mi}X_{Mi}=ar_i^{-b}\,P_{xi}X_i\qquad a,b\geqslant 0\tag{5}$$

Here equations (1) and (2) are the budget constraints in each of the two time periods, incorporating the cash-in-advance constraint, while equation (3) is the final period closure rule, imposing a constant savings rate $^1/_z$ in period 2. Equation (4) is a portfolio balance equation determining the relative shares of domestic and foreign assets in the consumer's savings on the basis of relative rates of return, deflated by the anticipated change in the exchange rate. Equation (5) determines the nominal demand for money as a function of the interest rate and current consumption.

The subsidies paid by the government to agriculture in period i, S_i, are given by

$$S_i = -t_i^a P_{Ai} Y_{Ai} + \overset{I}{\underset{j=1}{\Sigma}}{}^{s} t_i \delta(P_{si} - P_{Ai})^{j} x_{Ai}$$

$$+ \overset{I}{\underset{j+1}{\Sigma}} t_i^c \delta(P_{Ai} - P_{ci}) \overset{j}{X}_{Ai} + P_{Ai} w A_0.$$

Here t_i^a is the subsidy rate given to value added, Y_{Ai}, in agriculture in period i; P_{si} and P_{ci} are the support prices for agricultural output and consumption in period i. Hence, for example, $P_{si} - P_{Ai}$ represents the per unit subsidy paid to agricultural production if $P_{Ai} < P_{si}$, where P_{ai} is the market price of agriculture in period i [$\delta(y) = y;\ y \geqslant 0$ and $\delta(y) = 0;\ y \leqslant 0$]. $P_{Ai} w A_0$ represents the payments for set-asides where W represents the fraction of agricultural land subject to set-aside payments. Finally, tsi, tci represents the subsidy rates given to trigger price supports and consumption supports, respectively.

Parameter Estimates

The money demand equation used the form

$$\log M/p =$$

$$\underset{(2.0)}{-0.030 \log TD} \underset{(3.8)}{- 0.013 \log TB} \underset{(4.4)}{+ 0.100 \log GP} \underset{(18.5)}{+ 0.899 \log (M/p)} - 1$$

where

M = M1 + other checkable deposits less foreign deposits held
P = wholesale price index
TD = interest rate on time deposits
TB = interest rate on Treasury bills
GP = real GDP.

The numbers in parentheses are t-statistics. The coefficients for TD and TB in the simulations have been combined. This equation, taken from Wenninger and Sivesind (1979) was estimated using quarterly data over 1960–1979.

Exports were determined in a two-stage manner. Aggregate foreign demand for U.S. nonagricultural exports was first determined from an export elasticity with respect to relative prices of −0.98. The export elasticity with respect to world income is 0.90.[15] Demand for agricultural exports was then determined by a relative price elasticity of −0.82 and a world income elasticity of 0.51.

Production functions for value added in current production, as well as the investment function, were estimated using the *Economic Report of the President* (U.S. Government Printing Office, 1987), tables B-10, B-24. Effective tax rates for domestic industry were derived from tables B-23, B-77, and import duty rates were taken from tables B-74, B-99. Gross capital flows, which are exogenous, were taken to have their actual 1985–86 values, given in table B-103. Finally, all initial allocations were given the value of the corresponding stocks at the end of 1984. Capital and labor came from table B-103, land from B-93, money from B-64, and domestic and foreign bonds from B-81.

Notes

I would like to thank participants in the San Diego Conference of the Global Agricultural Trade Study for helpful comments on this chapter. The views expressed here do not necessarily reflect the opinions of the World Bank.

1. The simulation model that underlies this study is available upon request from the author. It is designed to run on a personal computer, and model changes may be easily incorporated in the program.

2. For a full description of this model see Marris (1985) (Technical Notes 1–2, pp. 269–87).

3. It is also possible that tax revenues may change as a result of these cuts. If they decline, it is highly unlikely that they would fall by as much as the cuts in subsidies, so that there would still be a net decline in the deficit.

4. There will be a second round of effects in which the exchange rate appreciates, owing to the improved trade balance, and imports increase, so that the full initial improvement in the trade balance is not realized.

5. This statement was reported in the *Washington Post* of 15 November 1987. A direct quotation is not available. In the same article Prime Minister Thatcher is also reported to have said that farmers in Japan were being paid eight times the world price to grow rice. In addition, she is quoted as saying, "and in Europe, believe it or not, the subsidy for every cow is greater than the personal income of half of the people in the world."

6. The theoretical structure of the analysis is based on Feltenstein (1986); Feltenstein, Lebow, and Sibert (1988); and Feltenstein and Morris (1987).

7. There are several consumers in the model, each of whom has different preferences. Hence the utility functions differ across consumers.

8. The price of money in period 1 is the numeraire; hence P_{M2} represents the purchasing power of money in period 2, relative to period 1. Thus if there has been an inflation P_{M2} would be less than 1.

9. See the appendix for the formulation of the subsidy.

10. In a dynamic model consumers save in order to finance future consumption. Hence in the final period we need to impose a savings constraint if all debt is not to be liquidated. Thus consumers save in period 2 according to an exogenously given rate, equal to the long-run savings rate of the economy. The government is therefore not required to liquidate outstanding debt at the end of period 2 and may run a deficit in that period. Thus the private savings rate is variable in period 1 and depends on future prices, while it is fixed in period 2.

11. It should be noted that the analysis does not require that the government run budget deficits. Indeed, it could run surpluses and use the surpluses to finance open market operations.

12. See Survey of Current Business (January 1983).

13. These figures are derived from Houthakker and Magee (1969).

14. Looking at the price level and exchange rate rows of table 7.3, the real exchange rate in, for example, the base case simulation reported in column 4 is given by $110.5 \times 0.794 = 87.7$. Recall that the nominal exchange rate is denominated in terms of units of foreign currency per U.S. dollar. This is not, however, equivalent to the real export price index, for which a different price level index is derived. Here agricultural exports have a much higher weight than they do in their domestic price index (approximately 13.8 percent in 1985 for their export price weight versus 2.3 percent for the corresponding GNP weight).

15. These figures are taken from Houthakker and Magee (1969).

References

Economic report of the president. 1987. Washington, D.C.: U.S. Government Printing Office.

Feltenstein, A. 1986. An intertemporal general equilibrium analysis of financial crowding out: A policy model and an application to Australia. *Journal of Public Economics* 31:79–104.

Feltenstein, A., D. Lebow, and A. C. Sibert. 1988. An analysis of the welfare implications of alternative exchange rate regimes: An intertemporal model with an application. *Journal of Policy Modelling* 10(4):611–29.

Feltenstein, A., and S. Morris. 1987. *Fiscal stabilization and exchange rate instability: A theoretical approach and some policy conclusions using Mexican data.* World Bank Discussion Paper no. CECEM 87-7. Washington, D.C.

Houthakker, H. S., and S. P. Magee. 1969. Income and price elasticities in world trade. *Review of Economics and Statistics* 51(2):111–25.

International Monetary Fund. 1987. *International financial statistics.* Washington, D.C.

Marris, S. 1985. *Deficits and the dollar: The world economy at risk.* Washington, D.C.: Institute for International Economics.

Stern, Robert M., J. H. Francis, and B. Schumacher. 1970. Price elasticities in international trade: A compilation and annotated bibliography of recent research. Ann

Arbor: Univ. of Michigan. Mimeo.

U.S. Department of Commerce. 1983. *Survey of current business.* Washington, D.C.: U.S. Government Printing Office.

Wenninger, J., and C. M. Sivesind. 1979. *Changing the M1 definition: An empirical investigation.* Federal Reserve Bank of New York Research Paper no. 7904. (April).

8. The Effect of Agricultural Trade Liberalization on the U.S. Economy: Projections to 1991

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Summary

By 1986 domestic policies to support farm income and trends in international markets conspired to reduce prices for agricultural goods to two-thirds of what they were, on average, in 1982. In running a computable general equilibrium model of the United States from 1982 to create a 1986 benchmark, we were able to account for this deterioration endogenously by setting farm policy instruments at their 1986 levels, increasing the U.S. government budget deficit (which put upward pressure on the exchange rate), and setting world market prices at their observed levels. In this study we explore whether or not that trend can be turned around, at least for the United States, by dismantling all distorting farm policies under the assumption that by 1991, both the U.S. trade and government budget deficits will be significantly reduced.

One of the fundamental macroeconomic assumptions underlying our base projection to 1991 is that the United States greatly expands exports. The U.S. agricultural sector is competitive in world markets and, given the real devaluation that must accompany macroeconomic adjustment, will account for a significant portion of these increased exports. The removal of producer subsidies in U.S. agriculture, if the rest of the world also liberalizes, does not compromise this important role.

If a failure to achieve agricultural trade liberalization should lead to a round of protectionist policies worldwide, the resulting shrinkage of world trade

could endanger the ability of the United States to achieve macroeconomic balance, with potential negative feedbacks to other economies. Thus, as a policy stance, the United States should seek liberalization. The question is whether the United States is willing to accept the structural adjustments that will necessarily accompany the changes in domestic agricultural policies involved in liberalization.

Our results suggest that the United States faces a classic trade liberalization dilemma. Policy reform leads to an improvement in GNP and a reduction in the trade and government budget deficits. But it also leads to changes in the functional distribution of income and to migration of labor out of the agricultural sectors. These are two of the problems that the agricultural subsidy programs were originally intended to redress. On the other hand, our experimental results do show gains outweighing losses from liberalization. Finally, the concomitant structural adjustment, at both the sectoral and macroeconomic levels, provides a firmer basis for future growth in an environment of freer trade.

Introduction

In recent years two trends have dominated world agricultural markets. First, there has been a steady increase in the rates of protection of the agricultural sector in developed countries. Second, there has been a dramatic drop in world prices of primary commodities. The decline in world prices, which was not met by an increase in demand, has led to spiralling costs of domestic support programs as governments sought to maintain farm incomes in the face of declining revenue from the world markets. Governments have come to realize that they operate in an increasingly interdependent world. Their domestic support policies have served to exacerbate the excess supply on both world and domestic markets since, in many countries, support has not been accompanied by programs to reduce output. The lesson is that policies with a primarily domestic focus can nonetheless have a significant impact on trade.

It is particularly difficult to measure the welfare effects of policy-induced distortions that have both domestic and international allocative impacts. The theoretical literature, which is largely concerned with the benefits of free trade in undistorted economies, provides little guidance on how to determine whether or not the removal of one of many distortions will improve welfare in a particular country. We might then turn to the second-best literature on gains from trade. This literature yields some counterexamples to the "universal gains from trade" proposition, but does not provide specific guidelines for assessing the impact on domestic welfare of the removal of a particular distortion.

The welfare gains (or losses) from reducing distortions in a tradable sector will depend on a number of factors. These include the size of the original distortion, the magnitude of the distortion relative to the difference between the undistorted domestic price and the world price, and the difference between the free trade domestic outputs and prices in the distorted and undistorted equilibria. In turn, the magnitudes of these differences will depend on elasticities of transformation between tradables and nontradables, sectoral trade substitution elasticities and trade shares, the price elasticity of demand for exports and price and income effects on the domestic demand side. These are likely to be commodity-, distortion-, and economy-specific.

To analyze this complex problem, we use an empirical approach by constructing a computable general equilibrium (CGE) model of the United States. The CGE model consists of a set of parameterized simultaneous equations that simulate a market economy and which are solved to yield equilibrium prices and levels of market activity. The parameters of the model include those required to determine the magnitudes of welfare changes arising from changes in policy instruments: measures of distortion, elasticities, shares, and the initial conditions reflected by sectoral structure of input use, output, and relative prices.

The present study analyzes the prospective impact of removing a particular set of distortions—producer subsidies in U.S. agriculture—on the structure of the economy in 1991. Agriculture is a major trading sector and has significant linkages with the rest of the economy, both forward and backward. Agricultural exports contribute significantly to the U.S. balance of trade. The major forward linkage is with the food- and fiber-processing sectors, the products of which comprise a large share of consumer expenditure.[1] Finally, agriculture is capital intensive and competes with other sectors for the employment of capital as well as of labor.

In this study we first outline the subsidy programs in U.S. agriculture in place through 1990–91 under the 1985 Farm Bill. We then describe the CGE model which is used to provide a base-run projection from 1986 to 1991, assuming the policies established by the 1985 Farm Bill remain intact. Next, a series of experiments is conducted to analyze the impact of removing the producer subsidies. Finally, we discuss implications for policy.

Producer Subsidies in U.S. Agriculture

In the United States federal and state programs targeting agriculture include some which distort production incentives, some which are intended to be pure income transfers, and others that seek essentially to internalize externalities. Here we are primarily concerned with the programs which influence production and marketing decisions. The criterion used to determine which programs directly influence supply and demand behavior is whether or not the policy instrument is an argument in the agent's behavioral equation. Accordingly we draw on the voluminous theoretical and applied literature analyzing the effect of U.S. farm programs on agricultural employment and output. We focus on the programs which distort production incentives and the domestic/imported commodity mix in the short run, and which affect the use of land in the medium to long run.

The other program expenditures are intended to be, and are treated as, either lump sum income transfers or expenditures on public goods. Agricultural research and extension can be seen as public goods by virtue of the lack of proprietary control over agricultural production technology. Soil conservation also represents a public good issue. These programs deal with externalities and are not considered to affect producer behavior at the margin.

In our model there are three agricultural sectors. The "dairy and meat" sector includes milk, eggs, poultry, and meat. The "grains" sector includes food and feed grains, as well as soybeans and cotton. The "other agriculture" sector includes sugar, tobacco, vegetables, and all other agricultural output. Agricultural programs differ between these sectors but are relatively homogeneous within each sector.

Programs which distort production incentives in the short run are measured ex post by a summary producer incentive equivalent (PIE) rate, calculated as the value of the subsidies paid to each sector divided by the value of sectoral output. In the United States in 1986, $25.9 billion was spent to support the agricultural sector in ways that distort producer incentives. For the three agricultural sectors in the model, these translate into the following PIE rates: 6.24 percent in dairy, 28.39 percent in grains, and 1.26 percent in other agriculture. The dollar values of the sum of price-increasing and cost-reducing transfers per sector are calculated from the data reported in the mid-session review of the Commodity Credit Corporation (U.S. Department of Agriculture 1987). The denominators for these rates are calculated using the input-output data that are the basis for the value of output in our model.

The dairy and meat sector subsidies arise from programs that support prices, restrict imports (both directly and through the use of quality controls), and subsidize exports. In particular, the price of milk is supported through a mandatory marketing order program that establishes the minimum price handlers must pay to milk producers. Milk production amounts to 17 percent of the value of output of the dairy and meat sector. The support price for milk is maintained by the existence of import quotas on processed milk products and government purchases of butter, cheese, and nonfat dry milk. As long as the quotas are binding, the domestic price of processed dairy products will be higher than the world prices. Then, if necessary, the government accumulates stocks to support the price processors pay to milk suppliers.

The export program operates by awarding a payment-in-kind to exporters of U.S. products to specified foreign markets that compensates exporters for the low competitive price paid by the importer. This selective export enhancement program (EEP) is available for dairy cattle, poultry, and eggs in the dairy and meat sector. An export enhancement program that operates in the same way as the export program in the dairy and meat sector is also in effect for wheat and some minor grains. This program reduces the downward pressure on market prices and loan rates exerted by excess domestic grain stocks.

The EEP is modeled as an ad valorem subsidy on exports of farm products. The ad valorem rate is the ratio of the EEP bonuses to the value of exports, by sector. In 1986 the export subsidies under the EEP amounted to 20.9 in dairy and meat, 3.6 in grains, and 1.0 in other agriculture.[2]

Direct subsidies in other agriculture are available for only a few crops in that sector, including sugar, tobacco, and peanuts. The price paid by processors to producers of sugar (about 5 percent of the value of the other agriculture sector) is supported by quotas on sugar imports and by a nonrecourse loan program. Government stocking and production quotas help maintain producer prices in the tobacco and peanut industries. Phytosanitary regulations and seasonal restrictions on fruit and vegetable imports also help to raise the market price of domestic production in the other agriculture sector.

In the grains sector market prices are supported by government accumulation of stocks under the nonrecourse loan programs, which apply to nearly 80 percent of the sector's output in value terms. Income support is provided to farmers who participate in acreage reduction programs through government transfers called deficiency payments. In 1986 participation in government programs rose to a record high, with (for example) over 85, 90, and 97 percent of farmland in wheat and corn, cotton, and rice, respectively, enrolled in the Acreage Reduction Programs.[3]

The deficiency payment rate is equal to the difference between the target price and the higher of the market price or the loan rate price, and is applied per unit of predetermined output.[4] The levels of the target and loan rate prices and the amounts of acreage to be withdrawn from production are determined in accordance with the provisions of the 1985 Farm Bill and announced before planting. The loan rate is set at 75–85 percent of past average market prices for the grains sector. The government's accumulation of commodity stocks in lieu of loan repayment supports the market price to some extent. Nevertheless, in 1986 the average loan rate was over 150 percent of the average market price.

Which (or what combination) of the target, loan rate, or market prices represents the incentive to produce? Clearly, given all the subsidy programs, the market price is not the determinant of the returns to labor, land, and capital in agriculture. For participants, the loan rate price is the value of the production forfeited under the loan program, but it is not a measure of total net returns to producers who participate in farm support programs since deficiency payments would also be included in total returns. Deficiency payments in 1986 almost doubled net farm income on grain farms. Farmers assume that eligibility for future payments depends on the current allocation of resources to program crops, so the target price provides an incentive for current resource allocation and the supply of grains. This conclusion is particularly true when participation in the programs is high, as is currently the case. While the loan rate and the market prices also have some effects on expectations and incentives, the target price appears to be the most important signal.

At issue is how to model supply behavior in the agricultural sectors. Econometric models include the target price relative to the market clearing price as a major determinant of land use under farm programs in agriculture.[5] Similarly, in our model the incentive signal for farmers is assumed to be the target price for 1985 through 1991, which has already been set according to the provisions of the 1985 Food Security Act.

In the dairy and meat and the other agriculture sectors, where the target prices are supported largely by the existence of import controls, and secondarily by government stock accumulation, we assume that the quotas reduce actual imports to half of their desired value, of given observed prices. Also, since the processed dairy products, against which the import quotas are applied, comprise a very small portion of the value in the light consumer sector, we assume that the quotas are levied against the raw products.

To model these agricultural programs, we calibrated the model for 1982 with target prices, loan rates, import quotas, export subsidies, land set-asides, and government stocking behavior in place. The model was then benchmarked for 1986 by setting those policy instruments at the 1986 levels relative to 1982, adding the Export Enhancement program export subsidies, which were not present in 1982. Given the target prices, resources are employed in the agricultural sector according to profit maximization behavioral rules. Market clearing prices are determined endogenously and simultaneously with production, the levels of government commodity accumulation, export supply, and domestic demand.

Two measures of sectoral subsidization are then calculated ex post—the PIE ad valorem rate and the producer subsidy equivalent (PSE). The PIE rate is calculated as the percentage difference between the exogenous target or support price and the endogenous market clearing price. This wedge represents the part of the output subsidy due to the existence of support prices, which has been paid by the government to producers. Since border measures and government stocking raise the market clearing price closer to the support price, the wedge between the market and the target price does not measure all of the incentive distortion arising from the programs.

The producer subsidy equivalent (PSE) is loosely defined as the amount of direct income transfer necessary to compensate the producer for the loss of the subsidy programs at the observed level of supply. It is estimated as the amount of income due to the programs in each sector. The PSE can be defined in relation to several bases: with respect to total income, the quantity produced, or the value of production (in terms of domestic or world prices). Following the OECD and USDA (1987), we use total sector income as the denominator. The PSE rate is then calculated as the ratio of income generated by the support programs to total income.[6] The PSE rates are not calculated using the exact same data as used in other studies, and will, of course, differ from calculations which use another base as denominator.[7]

The income due to programs includes deficiency payments, the value of excess stocking to support the market price, and part of the premium rent arising from quantitative restrictions. Since the import controls are on processed farm products, in this model the rents generated by the existence of quotas are first accumulated by the importing sector. The producing sector's share of the quota rents is assumed to be equal to the producer share of the retail value of the item. The value of the market price support provided by government stocking behavior is the value of government stock demand for program commodities in excess of normal carryover demand. Government stock demand is modeled as a function of the ratio of the market price to the loan rate, with a demand elasticity of 5.0. The sum of program-related sectoral income elements constitutes the numerator of the PSE ratio. The denominator is the sum of the sectoral program income, market income, and any other direct transfer payments to the sector.

A CGE Model of the U.S. Economy

Our U.S. CGE model is in the tradition of models developed for the analysis of trade policy.[8] The model equations describe the behavior of the various economic agents in markets for factors and commodities. It is neoclassical and Walrasian in spirit, solving for a set of relative prices (including the real exchange rate) that achieve full employment and flow equilibria in all markets.

There are ten sectors producing commodities for domestic use and for export: three agricultural sectors, five industrial sectors, and two service sectors.[9] The agricultural sectors are roughly categorized by trade shares. In the dairy and meat sector, both exports and imports are very low. In the grains sector, exports are very significant. Finally, other agriculture produces a heterogeneous mix of agricultural products for which there are smaller, but still significant, levels of exports and imports.

There are three primary factors of production: labor, capital, and agricultural land. The aggregate supplies of labor and capital are assumed fixed, but both factors are assumed to be freely mobile among sectors. Land is specific to two of the agricultural sectors (grains and other agriculture) and can be freely shifted between them. In this model, based in 1986, when program participation rates were high, the aggregate supply of cropland is bound from above under the set-aside constraints of the farm programs. For the "no program" experiments, land supply for crops is modeled as a fairly inelastic function of the ratio of the solution productive rate of return to the 1986 rate of return.[10]

The model is designed to perform experiments in a comparative-static framework spanning a period long enough so that it is reasonable to assume that sectoral investment is affected by changes in relative prices and policies. In equilibrium the model will determine average rentals for land and capital, and an average wage rate that clears the markets for land, capital, and labor. Different returns to land, labor, and capital among sectors are taken into account in the model by imposing fixed ratios of the factor return in each sector relative to the economywide average rate of return. These ratios are computed from the 1982 base year data.

Equilibrium solutions under existing policies represent allocations of labor and capital (implicitly, investment) among sectors that maintain the relative profit and wage distortions observed in the economy in the base year. The results of induced changes in sectoral investment (and disinvestment) are modeled by assuming intersectoral capital mobility. When agricultural subsidy policies are dismantled, these fixed ratios of rates of return to capital in agriculture are exogenously specified to fall to the economywide average, and capital investment is reallocated accordingly.

Production technology in all sectors is specified by Cobb-Douglas functions in labor and capital (and also in land in the two land-using agricultural sectors). Intermediate inputs are assumed to be required according to fixed input-output coefficients. This simple formulation is adequate for our present purposes, but is clearly worth extending.[11] Technological change, which is specified exogenously over time, is assumed to be Hicks (and Harrod) neutral, output-augmenting productivity growth.

On the demand side, the model includes the following actors who receive income and demand goods: households, government, capital account, and the rest of the world. There are three types of households in the model, categorized by income class, who own capital and land, and receive income from wages, profits, rents, and government transfers. Households pay taxes and save according to fixed average saving rates and then allocate their consumption expenditure according to a simple linear expenditure system.

The Treatment of Foreign Trade

The behavior of the "rest of the world" in the model is characterized very simply. On the import side, the United States is assumed to be a "small country" and hence can purchase as much imports as it wishes with no impact on world prices. For nonagricultural exports, the United States is also assumed to follow the small country assumption, with world prices fixed exogenously. For two of the three agricultural sectors, however, there are equations describing world export demand behavior as a function of U.S. export prices. World prices of exports are assumed to be inversely related to

U.S. agricultural export volumes, with fixed price elasticities.[12] The constants in these world demand functions are shifted up exogenously in the base-run projection to 1991, reflecting an assumed increase in world income in the 1986–91 period. The functions are of the form

$$E = EO * (PWE/PWSE)^{-ETA}$$

where EO is a constant, PWE is the world price of U.S. exports, PWSE is the exogenous world price of competing exports from other countries, and ETA is the elasticity of export demand.

The U.S. share of total world exports has fallen in recent years and is currently below 12 percent. For imports the share is around 15 percent.[13] In world agricultural trade, however, the United States is much more important. For example, the United States accounts for over half of the world grain trade.[14] These stylized facts imply that agriculture should be treated differently from nonagricultural trade, as we have done in the model.

Products in the model are distinguished by place of origin—domestic or foreign. The sector aggregation of the model was chosen to highlight the differences between sectors with respect to shares of domestic and foreign goods in production and consumption. Imports are assumed to be imperfect substitutes in consumption for domestically produced goods of the same sector classification.[15] Consumers purchase composite commodities which are constant elasticity of substitution (CES) aggregates of the imported and domestically produced good. The share of imports in sectoral demand is inversely related to the price of imports (PM in domestic currency) relative to domestically produced goods of the same sector classification (PD).

Producers in each sector supply a composite commodity which has to be transformed in order to be shifted between the domestic and export market. The sectoral composite is defined as a constant elasticity of transformation (CET) aggregate of exports and domestic market goods.[16] Sectoral supply behavior thus depends on the target price (TP) in the agricultural sectors, and on the composite good price (PX) in sectors without explicit distortions. PX is a weighted average of the domestic and export prices (PD and PE), net of indirect taxes. The proportion of output destined for the export market is positively related to the price of the good in world markets (PE in domestic currency) relative to the price in the domestic market (PD).

Given the distinctions in the model between imports and import substitutes, exports and goods destined for domestic demand, and composite commodities, the model specifies a number of different prices associated with each sector. The composite domestic demand price (P) corresponds to a retail sales price and is a weighted average of the domestic price of imports (PM) and the price of goods sold on the domestic market (PD), with the weights being the quantities of imports (M) and domestic goods sold on the domestic market (XXD) as ratios to composite good supply (X):

$$P = PM * (M/X) + PD * (XXD/X)$$

The domestic price of an import depends on the world price (PWM in foreign currency), the currency exchange rate (EXR), and any tariff (TM):

$$PM = PWM * EXR * (1 + TM)$$

The domestic price of an export (PE) is defined symmetrically, where any subsidy or tax on exports is given by TE:

$$PE = PWE * EXR * (1 + TE)$$

The composite producer price (PX) is a weighted average of the domestic price of exports (PE) and the price of goods destined for the domestic market (PD), with the weights coming from the CET export aggregation function. Producers make supply decisions based on the value added price (or net price), which is defined as

$$PVA(i) = PX(i) * [1 - ITAX(i) + PIE(i)] - SUM\ [j,\ P(j)*A(j,i)]$$

where ITAX is the indirect tax rate, PIE is the producer incentive equivalent, P is the composite good price (defined earlier), and the As are the input-output coefficients. The subscripts i and j refer to sectors, and SUM is the summation operator. Given that input-output coefficients are fixed, changes in PVA measure changes in "resource pull" effects. A sector whose relative value added price rises, whether due to increases in PX or changes in taxes and subsidies, will tend to pull resources away from other sectors.

For the nonagricultural sectors, PIEs equal zero. For the agricultural sectors, as discussed above, it is assumed that producers respond to an exogenous target price, and hence to a value added price where the target price replaces PX. In these sectors the PIE is determined endogenously to reflect the difference between the target price and the solution market price.

The model is Walrasian in that only relative prices matter. Thus, in addition to these sectoral prices, one must specify a numeraire good whose price is set to one, thereby defining the base for all relative price computations. In this model, the GNP deflator is chosen as numeraire and is set to one in the base year (1982). For the 1986 base, the value of the GNP deflator is set to its actual value, which is then kept fixed in the forward projections to 1991. Thus, all 1991 nominal magnitudes solved in the model can be interpreted as being roughly in 1986 prices, since the model solution is "normalized" on the 1986 GNP deflator. One must also interpret the solution prices as being relative prices, relative to the fixed GNP deflator.[17]

The balance of trade constraint can be written (summing over sectoral imports and exports) as

$$\text{SUM}\ [(\text{i},\ \text{PWM}(\text{i})^*\text{M}(\text{i})] = \text{SUM}\ [\text{i},\ \text{PW}(\text{i})^*\text{E}(\text{i})] + \text{FSAV} + \text{FBOR} + \text{REMIT}$$

where FSAV represents foreign capital inflows, FBOR is net foreign borrowing by the government, and REMIT is remittance income from abroad. In the base run, each of these items (FSAV, FBOR, and REMIT) is specified exogenously, so the model must adjust to a fixed balance of trade. The equilibrating variable is the exchange rate (EXR). Changes in the equilibrium exchange rate, however, must be seen as changes in a relative price, given the choice of numeraire (the GNP deflator). The equilibrating mechanism is through changes in the real exchange rate, which is the relative price of tradables to domestic goods sold on the domestic market. Thus the real exchange rate must depreciate if the exogenous balance of trade is required to improve, or appreciate if the balance of trade is assumed to worsen. Given the choice of numeraire, there will be a monotonic relationship between changes in the "nominal" exchange rate in the model and changes in the real exchange rate, but the two will not be equivalent.[18]

In the various experiments, an alternative foreign closure is used. The exchange rate is fixed at the 1991 solution level, while foreign savings are allowed to adjust to any change in the endogenous balance of trade. Thus, FSAV indicates the status of the current account.

Macroeconomic Closure

The model determines only flow equilibria and does not include any assets or asset markets. It does, however, incorporate the major macroeconomic aggregate nominal balances:

$$\text{Z} = \text{SH} + \text{SG} + \text{F}$$
$$\text{SG} = \text{T} - \text{G}$$
$$\text{F} = \text{M} - \text{E}$$

where Z is aggregate investment, SH is total private savings, SG is government savings, F is foreign savings (the balance on current account), T is total government revenue, G is government expenditure, M is aggregate imports, and E is aggregate exports. Much effort and controversy have revolved around describing how an economy achieves balance among these macroeconomic aggregates. For our analysis, in which we assume full employment and exogenous inflation, the issue is relatively straightforward. Our focus is on the impacts of exogenous changes in macroeconomic aggregates on sectoral structure, not on interactions among macroeconomic aggregates.

The government receives revenue from taxes and spends it on goods, transfers to households, program commodity stock accumulation, and subsidies to producers. Government expenditure on commodities is allocated among sectors according to observed shares. The government also borrows from (or lends to) the rest of the world, with the amount fixed exogenously. Aggregate government expenditures on goods and transfers are fixed exogenously, and the government is assumed not to be subject to a revenue constraint.[19] Any deficit or surplus in the government budget is determined residually and is assumed to be balanced by a withdrawal from, or injection into, the loanable funds market. The model thus embodies the macro assumption of perfect crowding out or in of government deficits or surpluses.

Investment is "savings driven" in the model. In effect, there is a loanable funds market which gathers savings from all sources (private, government, and foreign) and allocates them to the purchase of investment goods.[20] Private savings are determined by fixed savings rates out of disposable income. Foreign savings are given exogenously for the base run and projection, but are endogenous in the experiments. Government savings (or deficits) are determined endogenously, given government expenditure and endogenously determined revenue.

In the experiments reported below, major changes in the balance of trade and government spending are assumed to occur between 1986 and 1991. Given the assumption of full employment, these changes can have little or no effect on aggregate GNP. One focus of the analysis of the forward projection, however, is on the impact of shifts in macro aggregates on the sectoral structure of demand, supply, value added, and prices. For this analysis, we consider only one macroeconomic scenario, which is discussed in the next section. The ultimate focus is on the impact of changes in sectoral incentive policies and in world market conditions—trade liberalization—on the economy. In these experiments, the macroeconomic scenario is held constant,

Table 8.1 Sectoral Composition of National Income, Trade Shares, and Elasticities

	Sectoral composition (in percentage)				Trade shares (in percentage)		Elasticities	
Sector	Value added	Gross output	Exports	Imports	Exports/ output	Imports/ output	Import subs	Export trans
Dairy and meat	.30	1.20	.06	.14	0.25	0.86	2.00	0.50
Grains	.95	1.18	5.90	.02	26.50	0.11	4.00	4.00
Other agriculture	.77	0.78	.51	1.08	3.36	10.38	4.00	2.00
Sum/average	2.02	3.16	6.47	1.24	—	—	—	—
Light consumer	6.94	10.90	7.18	10.39	3.48	7.18	2.00	2.00
Basic intermediate	9.94	13.84	11.37	34.46	4.34	18.76	0.75	2.00
Capital goods	5.07	8.37	20.58	20.54	12.99	18.50	0.75	2.00
Construction	4.94	7.31	.02	—	.01	—	0.90	1.50
Electronics	1.94	2.26	4.76	9.63	11.13	32.08	1.10	2.00
Sum/average	28.83	42.68	43.91	75.02	—	—	—	—
Trade and finance	16.85	14.47	6.58	—	2.40	—	0.20	0.00
Other services	52.30	39.69	43.04	23.74	5.73	4.51	0.20	0.60
Sum/average	69.15	54.16	49.62	23.74	—	—	—	—
Total/average	100.00	100.00	100.00	100.00	—	—	—	—

Note: — indicates not applicable.

although the government budget deficit is still determined residually.

The sectoral composition of value added, the shares of exportable goods production by sector, the ratio of imported goods to domestic production, and the main parameters of the model for 1986 are presented in table 8.1[21] These data provide a picture of the economy in the base year and are useful for understanding the experiment results reported below.

The 1986–91 Base Run

All of our liberalization scenarios start from a baseline, five-year projection from 1986 to 1991. This base run of the model consists of a comparative static experiment which starts from a solution for 1986 and is solved assuming annual rates of growth in exogenous variables over the five years to 1991. These assumptions are compared to recent historical rates of growth in table 8.2. The modeled growth in GNP is driven by assumptions about exogenous growth rates of total factor productivity (1.7 percent per year), the capital stock, and the labor force.

We have chosen to model a single macroeconomic scenario for the projec-

Table 8.2 Annual Growth Rates of Selected Variables

Variable	Annual growth rates (percentage) Actual 1982–1986	Base run 1986–1991
Consumption	4.6	2.1
Investment	10.0	1.1
Government	4.1	0.7
Exports	1.1	6.6
Imports	11.7	2.2
GNP	4.1	2.1
Agricultural value added	2.8	−2.7
Factor inputs		
Capital	2.6	2.4
Labor	2.4	1.2

Note: "Actual" rates of growth calculated from data in U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of current business* (1986). "Base run" rates calculated with respect to model solution. "Rate" is the percent annual compound rate of growth.

tion to 1991 as the base solution. Counterfactual experiments consisting of different agricultural policy mixes are conducted with respect to this base; that is, assuming no change in this basic macroeconomic projection. Comparisons of liberalization scenarios against the base are relatively insensitive to variations in the macro assumptions. The projected macroeconomic structure is compared to the current situation in table 8.3. The most important assumptions are that, as shares of GNP, the government deficit shrinks and net exports increase.

The macro scenario for the 1986–91 period is mildly optimistic. The government deficit is assumed to fall by $113 billion to $34.5 billion, largely by not permitting significant growth in real government expenditure rather than by tax increases.[22] As the government deficit shrinks, so does the trade deficit, by assumption.

The improvement in the foreign trade balance accompanies the projected devaluation of the real exchange rate. Earlier analysis of the 1982–86 period with a related model indicated that macro policy choices leading to a large government deficit and trade deficit were responsible for the major real revaluation observed in the period.[23] With the assumed reversal of these swings in macro aggregates in the 1986–91 period, the real exchange rate is projected to move slightly above its 1982 value. In both periods an implication of the analysis is that the movements in real exchange rates are largely the result of U.S. policy choices, rather than any policy choices by other countries.

Table 8.3 Composition of GNP (current prices)

Share of GNP	Actual 1982	Actual 1986	Base run 1991
Consumption	64.8	66.1	65.9
Investment	14.1	15.9	16.7
Government	20.3	20.5	18.9
Exports	11.4	8.9	12.6
Imports	10.6	11.4	14.1
Agricultural value added	2.8	2.2	1.8
Government deficit	3.5	3.5	.73
Exports-imports	0.6	−2.5	.29

Note: "Actual" data are from the U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of current business* (July 1987). "Base Run" data are the results of the base forward projection to 1991. "Agricultural value added" in the National Income and Product Accounts (NIPA) include, by definition, imputed rent from owner-occupied dwellings, which are included instead in the service sector in the input-output accounts. The model results are adjusted to be consistent with the NIPA definition. The trade deficit (exports-imports) also follows the NIPA convention and equals the current account balance.

As shown in table 8.4, the real exchange rate (the price of nontradables relative to the price of tradables) revalues in the 1982–86 period by 18.8 percent and then devalues in the 1986–91 period, with the index falling to 0.6 percent above the 1982 base value. The devaluation is necessary to boost exports and reduce import demand, according to the projected improvement in the trade balance. The nominal exchange rate also devalues by about 20 percent.

The agricultural sectors benefit from the devaluation and the small improvement in the international terms of trade relative to 1986, with exports increasing 20 percent over the projection period. Otherwise, agriculture's contribution to the overall economy shrinks during the projection period because of the falling value of agricultural output under the assumed conditions of continuing excessive supply at market prices. Although target prices increase to 1991 according to the provisions of the 1985 Farm Bill, loan rates fall closer and closer to the market clearing prices and land set-aside constraints continue to bind. Excess supplies accumulate and government stocking tops out, with the result being relatively low market returns in agriculture. The PSE rates are much higher in 1991 than in 1986, with 75 percent of the net income for grains coming from government programs.

Table 8.4 Various Price Indices (1982 = 100)

Variable	Actual 1986	Base run 1991
GNP deflator	114.1	114.1
World price of exports	97.8	94.8
World price of imports	88.8	88.8
Nominal exchange rate	100.0	120.1
Real exchange rate	118.8	100.6
Domestic price of exports	103.6	114.4
Domestic price of imports	92.6	109.8
Domestic sales price	116.6	112.4
Cost of living	113.2	113.1
Real wage	105.1	110.7
Agricultural terms of trade		
Output prices	83.5	82.8
Value added	76.6	80.8
World prices, imports	108.5	109.3

Trade Liberalization Experiments

All trade liberalization experiments have been conducted with respect to the base solution for 1991. The projected rates of growth of productivity, aggregate supplies of primary factors of production, and the levels of nonagricultural program federal spending for 1991 remain the same throughout the experiments. In order to focus on the effects of agricultural policy changes, we also assume that the exchange rate remains at the projected 1991 solution level, with foreign savings adjusting to maintain balance between the current and the capital accounts at that exchange rate. The experiments consist of varying the agricultural subsidy program instruments, first one by one, and then in various combinations.

The first set of experiments demonstrates the impact of the separate components of the U.S. farm programs: resource use constraints, border measures, and domestic price and income supports. We model the economy with one set of distortions removed, while the other distortions are left intact. These experiments thus measure the direct general equilibrium impact of each distortion on output, trade, and prices. The experiment "Land" relaxes the constraints on land use imposed on the farm sector under the subsidy programs. The experiment "Border" removes the protection offered by the border measures. The quotas on imports of dairy and other agricultural goods are removed, and the export subsidies are repealed, while the target price and loan rate programs remain operative, and the resource constraints are still binding. The third experiment, "Domestic," maintains the border measures, but repeals the domestic income protection provided by the target price and loan programs. The fourth experiment, "All subsidies," removes both border and domestic subsidies, while leaving the land use constraints intact.

The removal of distortions alone results in increases in economywide output, while the relaxation of resource constraints in addition leads to further improvements in GNP. In the second set of experiments, both the subsidy programs and the resource constraints are relaxed. The first of this set, "Unilateral," consists of relaxing land constraints and removing all subsidies, without assuming any cooperation from the rest of the world on agricultural trade liberalization. Finally, we calculate the qualitative results of multilateral liberalization in experiment "Multilateral," in which all features of U.S. farm programs are removed, and world agricultural prices are assumed to increase.

Summaries of the experiment results are presented in tables 8.5 to 8.9. Table 8.5 presents the consumption, investment, trade, net absorption, and the government budget deficit results of the various experiments relative to the base run for 1991. Table 8.6 displays some of the more important agricultural sector variable results expressed as ratios to the base run results, and table 8.7 displays the same variables for the nonagricultural sectors. Table 8.8 compares the income and value added by sector under the experiments to the base run. The results in tables 8.5 and 8.8 are further disaggregated into agricultural and nonagricultural subsets. Table 8.9 presents the elasticities of response of these variables with respect to increases in the prices of competing agricultural products on world markets.

Experiment 1: Land Constraints Relaxed

Not all aspects of U.S. agricultural subsidy programs directly promote excess supplies from the United States and exacerbate falling world market prices. One of the most important features of the U.S. program is the constraint on resource use required of the major beneficiaries of support. In order to be eligible for deficiency payments and nonrecourse loans, the farmer must take land out of production. The set-aside constraint is intended to offset the production-inducing signal provided by the target price, control total output,

Table 8.5 Real Absorption in 1986, 1991, and Differences from 1991 by Experiment (in billions of 1982 dollars)

		Level		Difference from 1991				
		1986	1991	Land	Border	All	Uni	Multi
Consumption	total	2482.9	2720.3	15.3	2.6	−18.6	−16.4	−13.8
	ag	27.9	29.9	1.0	0.6	−1.1	−0.8	−1.9
	non-ag	2455.0	2690.4	14.2	2.1	−17.5	−15.6	−11.9
Investment		629.0	690.9	−35.3	0.3	36.0	35.7	12.8
Government	total	755.3	781.2	9.6	0.9	5.2	5.2	5.2
	ag	15.0	4.6	9.6	0.9	5.2	5.2	5.2
	non-ag	740.3	776.6	0.0	0.0	0.0	0.0	0.0
Exports	total	378.8	519.7	12.1	0.9	−7.3	−6.5	8.2
	ag	17.5	21.5	17.2	0.8	−10.8	−10.3	6.4
	non-ag	361.3	498.2	−5.2	0.2	3.5	3.8	1.8
Imports	total	534.5	582.6	−2.6	4.3	9.3	9.1	3.4
	ag	6.8	6.7	−0.0	4.3	4.6	4.4	1.2
	non-ag	527.7	575.9	−2.5	0.1	4.8	4.8	2.2
GNP	total	3711.7	4130.0	3.0	0.5	6.7	9.6	9.1
	ag	65.0	38.1	26.9	−1.9	−10.7	−9.7	8.4
	non-ag	3646.7	4091.9	−23.9	2.5	17.3	19.3	0.7
Absorption	total	3867.2	4192.4	−10.5	3.8	22.5	24.4	4.2
	ag	42.9	34.5	10.6	1.4	4.0	4.3	3.3
	non-ag	3824.4	4157.9	−21.1	2.4	18.4	20.1	0.9
Net exports	total	−155.7	−62.9	14.6	−3.4	−16.7	−15.6	4.8
	ag	10.8	14.8	17.3	−3.5	−15.4	−14.6	5.1
	non-ag	−166.5	−77.8	−2.6	0.1	−1.3	−1.0	−0.4
Govt. deficit		147.9	34.5	31.7	3.0	−25.1	−26.1	−25.7

and thus limit the budgetary exposure. In principle, the existing program is designed to protect farm income without generating surpluses at the prevailing domestic market prices.

The United States has also supported world market prices through the stock accumulation activities under the nonrecourse loan program. In effect, until the 1985 Farm Bill, the loan rates announced in advance of the marketing period represented the U.S. price floor, and since the U.S. share of world agricultural trade is large, they also signaled a world price floor. Under the 1985 Farm Bill, loan rates are set in reference to average market prices, and are negatively related to the level of stocks. Therefore, market prices indicate the loan rate rather than vice versa. Nevertheless, even under the

Table 8.6 Agricultural Sector Experiment Results (1991 = 100)

Experiment Sector	World price	Signal price	Capital rental	Land rent	Land	Labor	Capital	Output	Export	Imports
Land										
Dairy and meat	97.7	90.8	83.5			90.1	108.5	103.2	107.1	100.0
Grains	80.4	100.0	96.4	102.6	132.2	139.9	145.9	136.7	192.2	31.4
Other agriculture	101.7	104.7	129.8	102.6	102.0	107.9	83.6	100.7	95.0	100.0
Border										
Dairy and meat	102.7	98.7	100.1			99.4	99.4	99.4	92.2	200.2
Grains	98.5	100.0	100.1	100.0	101.9	103.0	102.9	102.3	104.8	80.3
Other agriculture	101.7	100.2	100.1	100.0	93.6	94.6	94.6	94.2	95.1	159.3
Domestic										
Dairy and meat	102.7	112.6	99.2			96.4	96.7	96.6	92.3	100.0
Grains	130.7	98.1	99.2	85.6	97.4	82.2	82.4	91.4	44.8	696.6
Other agriculture	99.8	95.9	99.2	85.6	108.9	91.9	92.1	98.8	100.7	100.0
All subsidies										
Dairy and meat	106.0	111.9	99.2			94.6	94.9	94.8	83.9	315.9
Grains	132.5	96.7	99.2	81.4	98.0	79.3	79.5	90.6	43.0	656.2
Other agriculture	100.6	94.9	99.2	81.4	106.9	86.5	86.8	94.7	98.3	144.3
Unilateral										
Dairy and meat	104.9	107.1	82.1			83.5	101.3	96.1	86.5	268.4
Grains	129.8	93.6	94.8	74.4	101.1	75.4	79.2	91.8	45.8	578.0
Other agriculture	100.8	95.4	127.6	74.4	117.0	87.2	68.1	94.6	97.6	147.4
Multilateral										
Dairy and meat	111.4	107.6	82.2			84.6	102.3	97.2	89.9	181.5
Grains	148.3	98.6	94.9	87.3	115.5	102.5	107.4	111.9	134.3	145.1
Other agriculture	103.9	99.7	127.7	87.3	109.3	96.9	75.4	97.6	97.8	109.3

Note: "World price" is the price foreigners pay for U.S. agricultural products. "Signal price" equals the target price or support price when domestic programs are operative; equals market price without programs. "Capital rental" and "Land rent" are the marginal revenue products of capital and agricultural land.

current program, farmers repay the loans by forfeiting crops and thus diverting supplies off the market, if the market price is not high enough relative to the loan rate to be profitable. Thus, the loan rate continues to serve as an indicator of U.S. prices to the rest of the world.

In the first experiment, "Land," we consider what might happen if U.S. farmers were not subject to resource use constraints while the subsidy programs remain in effect. The experiment consists of projecting to 1991 with subsidies, while land supply is determined endogenously rather than constrained to the set-aside level under the 1985 Farm Bill. The amount of land in production increases by 32.2 percent for grains and 2.0 percent for other

Table 8.7 Nonagricultural Sector Experiment Results (1991 = 100)

Sector	PVA	PX	Labor	Capital	Output	Export	Import
Land							
Light consumer	100.7	98.9	101.4	100.9	101.2	103.5	98.8
Basic intermed	100.7	100.6	99.9	99.4	99.7	98.5	100.2
Capital goods	100.5	100.5	97.5	97.0	97.5	96.5	98.1
Construction	100.6	100.5	96.9	96.5	96.9	96.2	—
Electronics	100.6	100.5	98.7	98.2	98.6	97.7	99.4
Trade	100.6	100.6	100.0	99.5	99.9	99.6	—
Services	100.7	100.6	100.2	99.7	100.0	99.6	100.1
Border							
Light consumer	100.1	99.7	100.3	100.3	100.3	100.9	99.6
Basic intermed	100.1	100.0	100.0	100.0	100.0	99.9	100.1
Capital goods	100.1	100.1	100.0	100.0	100.0	99.9	100.1
Construction	100.1	100.0	100.0	100.0	100.0	100.0	—
Electronics	100.1	100.0	100.0	100.0	100.0	99.9	100.1
Trade	100.1	100.1	100.0	100.0	100.0	100.0	—
Services	100.1	100.1	100.0	100.0	100.0	100.0	100.0
Domestic							
Light consumer	99.4	102.5	97.6	97.8	97.7	93.0	103.2
Basic intermed	99.3	99.6	100.5	100.7	100.6	101.5	100.2
Capital goods	99.4	99.6	102.3	102.5	102.3	103.1	101.8
Construction	99.4	99.7	102.8	103.0	102.8	103.3	—
Electronics	99.4	99.7	101.2	101.4	101.2	101.8	100.6
Trade	99.4	99.6	100.1	100.3	100.2	100.4	—
Services	99.4	99.6	99.9	100.2	100.0	100.3	99.9
All subsidies							
Light consumer	99.4	102.2	97.8	98.1	97.9	93.6	102.8
Basic intermed	99.4	99.6	100.6	100.9	100.7	101.5	100.3
Capital goods	99.5	99.6	102.6	102.9	102.6	103.4	102.1
Construction	99.5	99.7	103.2	103.5	103.2	103.7	—
Electronics	99.5	99.7	101.3	101.6	101.3	102.0	100.8
Trade	99.4	99.6	100.1	100.4	100.2	100.5	—
Services	99.4	99.6	99.9	100.2	100.0	100.3	99.9
Unilateral							
Light consumer	99.5	101.7	98.3	98.6	98.4	95.2	102.1
Basic intermed	99.5	99.7	100.6	100.9	100.7	101.4	100.4
Capital goods	99.6	99.7	102.5	102.8	102.5	103.1	102.1
Construction	99.6	99.7	103.2	103.5	103.2	103.6	—
Electronics	99.6	99.8	101.3	101.6	101.3	101.8	100.9
Trade	99.6	99.7	100.2	100.5	100.2	100.4	—
Services	99.5	99.6	99.9	100.2	100.1	100.3	100.0
Multilateral							
Light consumer	99.4	101.9	98.1	98.1	98.1	94.4	102.3
Basic intermed	99.4	99.6	100.6	100.5	100.6	101.3	100.2
Capital goods	99.4	99.6	101.2	101.2	101.2	102.0	100.6

Table 8.7 continued

Sector	PVA	PX	Labor	Capital	Output	Export	Import
Construction	99.4	99.7	101.2	101.2	101.2	101.6	—
Electronics	99.4	99.7	100.7	100.7	100.7	101.4	100.1
Trade	99.4	99.6	100.1	100.1	100.1	100.4	—
Services	99.4	99.6	100.0	100.0	100.0	100.3	99.9

over the base 1991 projection, equivalent to 15.6 percent overall. This nearly equals the minimum set-aside rate in 1986 for program crops under the 1985 Farm Bill (table 8.6).

The deficiency payment responsibility that arises due to the relaxation of acreage controls is costly to the government. The government budget deficit almost doubles, government stock accumulation increases by almost $10 billion, and foreign capital inflows increase by 60 percent. Real GNP increases by about $3 billion due to the increase in resources used in production (table 8.5). Farm income, of course, improves under these assumptions. Subsidy ridden net returns to land, labor and capital in the grains sector increase by 40 percent. In the other sectors of the economy, value added falls (table 8.8). Savings and investment also fall to only 95 percent of the base projection levels. But what havoc is wreaked on international markets for grain!

U.S. exports of grains almost double, while imports of grains (small to begin with) fall by two-thirds (table 8.6). The world price of grains falls almost 40 percent from the 1986 level, an additional 20 percent lower than the world price relative to the base 1991 projection. This occurs because we have modeled the loan rate following the falling U.S. market prices to a certain extent, according to the provisions of the 1985 Farm Bill. The balance of trade deficit improves by $14 billion. This includes a $17 billion improvement in net agricultural exports, and a $3 billion deterioration in net nonagricultural trade (table 8.5).

Experiment 2: Border Policies Removed

Traditionally, the GATT has been concerned with border measures, especially quotas on imports and subsidies on exports. The progenitors of the proposals to the Uruguay Round of the GATT negotiations have correctly identified that the most trade-distorting farm support policies are not the border measures but the domestic programs. Breaking with the GATT tra-

Table 8.8 Sector Income: Differences between 1991 and Experiments

		Difference from 1991				
Sector	Level 1991	Land	Border	All	Uni	Multi
Sector income (billions of 1991 dollars)						
Dairy and meat	25.867	−2.5	−0.2	−1.6	−4.4	−4.2
Grains	44.718	18.2	1.4	−9.4	−11.1	0.8
Other agriculture	38.145	3.3	−2.1	−5.4	−5.0	−1.4
Light consumer	315.185	6.0	1.2	−8.5	−6.4	−7.8
Basic intermed	426.345	1.7	0.4	0.3	1.0	−0.1
Capital goods	261.334	−5.3	0.2	5.4	5.5	1.6
Construction	237.532	−6.1	0.2	6.3	6.6	1.4
Electronics	93.742	−0.8	0.1	0.8	0.8	0.1
Trade	687.059	3.7	0.7	−2.5	−1.5	−3.1
Services	2232.512	15.8	2.2	−12.9	−9.9	−12.0
Agriculture	108.73	19.0	−0.9	−16.4	−20.6	−4.8
Nonagriculture	4253.709	15.1	4.9	−11.1	−3.9	−20.0
Total	4362.439	34.1	4.0	−27.5	−24.5	−24.7
+ indirect taxes	367.951					
+ tariffs	16.723					
− subsidies	34.708					
− ag premium rents	.129					
= value added	4712.276					
Value added (billions of 1991 dollars)						
Dairy and meat	27.730	−2.5	−0.2	−1.4	−4.3	−4.0
Grains	12.956	−13.6	−2.5	23.7	22.0	34.3
Other agriculture	37.529	3.2	−2.0	−3.4	−3.1	0.6
Light consumer	336.935	6.1	1.2	−8.5	−6.4	−7.8
Basic intermed	474.449	1.8	0.4	0.4	1.2	−0.0
Capital goods	270.099	−5.4	0.2	5.6	5.7	1.6
Construction	244.196	−6.2	0.2	6.5	6.8	1.5
Electronics	95.901	−0.8	0.1	0.8	0.9	0.1
Trade	794.563	4.2	0.8	−2.7	−1.6	−3.4
Services	2417.918	16.7	2.4	−13.3	−10.2	−12.5
Agriculture	78.215	−12.9	−4.7	18.9	14.5	30.9
Nonagriculture	4634.061	16.3	5.2	−11.3	−3.7	−20.5
Total	4712.276	3.4	0.5	7.6	10.9	10.4

dition, they have agreed that all agricultural subsidy programs are subject to consideration in this round of the GATT.

The "Border" experiment, in which only border distortions are dismantled, is designed to highlight the relative importance of border and domestic measures. In the United States border measures supporting exports are relatively minor, while protection against certain imports is very important (see quotas against imported cheese and sugar).[24] The results of this exercise should then be compared with the results of the "Domestic" experiment (next), to highlight the importance of bringing domestic measures under the GATT. Including domestic support programs under the GATT is shown to be important, particularly if the objective is to reduce potential budget exposure and to strengthen world agricultural prices.

In the "Border" experiment, the quotas against imports of dairy and meat and other agriculture products are removed, and the ad valorem export subsidies for all agricultural exports are dropped to zero. Meanwhile, the constraints on land in production and the domestic price and income support programs remain intact.

The removal of the border measures results in a tiny increase in real GNP, a $3.4 billion deterioration in the net balance of trade (due entirely to lower net exports from agriculture), a corresponding increase in foreign savings in the United States, and an increase in the government budget deficit of about $3 billion (table 8.5), while expenditures to support the farm sector increase by $3.8 billion, or 10 percent. The effect on nonagricultural sector employment, output, and prices is likewise negligible. Only the light consumer goods sector is affected (table 8.7). Lower domestic costs of raw agricultural product inputs to the light consumer goods industries reduce intermediate input costs, increasing value added and income in that sector by about $1 billion (table 8.8).

Imports of dairy and meat and other agriculture products increase by $0.8 and $3.5 billion, respectively, when the import quotas are removed. Exports fall insignificantly. Land is released from the other agriculture sector into the grains sector, and production of grains increases accordingly by about 2 percent. Exports of grains increase by 4.8 percent, and imports fall by 20 percent, affecting a decline in world prices of 1.5 percent (table 8.6).

The "Border" experiment illustrates how little would be achieved if only U.S. border measures were dismantled. The effect on world markets appears quite small. Meanwhile, costs of domestic programs and the government budget exposure increase, although not prohibitively. These results underscore the importance of including both border measure liberalization and domestic programs under the purview of the GATT.

Experiment 3: Domestic Subsidies Terminated

The third experiment, "Domestic," focuses on the impact of U.S. domestic policies on domestic resource allocation, the government budget deficit, and net agricultural trade. We remove the income support provided by the target price programs and the part of domestic price support provided by government stock accumulation activities. The constraints on resource use and the border measures remain in effect.

The main impact of the removal of domestic support programs is a movement of labor and capital out of agriculture. Capital and labor both decline to 96, 82, and 92 percent of the subsidy-ridden 1991 levels in the dairy and meat, grains, and other agriculture sectors (table 8.6). Production likewise falls, although less so in other agriculture, into which land moves from the grains sector. U.S. grain exports fall dramatically, imports increase, and domestic grain prices increase by 60 percent (table 8.6). The cost of living increases by 0.2 percent, as these cost increases at the unprocessed level are passed through to the rest of the economy as farm products are processed.

The light consumer goods sector suffers along with the agricultural sectors. Employment, output, and exports decline by a few percentage points, and light consumer goods imports increase (table 8.7). The $2.0 billion deterioration in net trade in light consumer goods accounts for most of the nonagricultural net trade deterioration. Overall, the net trade balance worsens by $12 billion. The loss of $10 billion worth of grains net exports accounts for most of this deterioration in the trade deficit ("Domestic" results not shown in table 8.5).

The savings to the government due to termination of the domestic programs results in a $24.2 billion reduction in the deficit, and hence less of a drain on the loanable funds market. Savings and investment increase by $30.0 billion, and the current account deteriorates by $5.7 billion.

The reduction in U.S. grain exports precipitates a 30 percent increase in the world price of grains. Taken together, the implications of this experiment are that terminating domestic programs may have the largest desired effects of strengthening world agricultural markets and reducing government budget exposure.

Experiment 4: All Subsidy Programs Terminated

In the "All subsidies" experiment, all direct price support activities and border measures in agriculture are removed, without relaxing the acreage constraints that accompany the subsidy programs. This experiment is essentially the sum of experiments 2 and 3. The experiment isolates the impact of the incentive-distorting effects from the resource-constraining effects of the existing farm programs. The direct effect of removing the programs is to reallocate factors out of agriculture into sectors where they are more productive. Overall, real GNP increases by $5.8 billion and nominal by $6.7 billion (0.14 percent) when the agricultural subsidy programs are terminated (table 8.5).

In particular, in this exercise there are no target prices or loan rates. Government stocking of program commodities to maintain market prices through the nonrecourse loan program is discontinued. The import quotas are repealed. The export enhancement program subsidies drop to zero. Having removed the wedges between TP and PX, and the tariff equivalent distortions between the domestic and world prices for traded agricultural goods, the market clearing price (PX) signals resource allocation economywide.

Economywide, more is produced, consumed, saved, and invested when all distortions subsidizing the agricultural sectors are removed. Real GNP increases by $5.8 billion compared to the subsidy-ridden 1991 projected level of GNP. The federal deficit is reduced by 25.1 billion, from $34.5 billion to $9.4 billion (table 8.5). The reduction in the deficit is due to a $34.7 billion savings from agricultural subsidies no longer paid, net of expenditure on 1991 stock holding.[25] In the 1991 base solution, the government was releasing stocks from previous excessive accumulations, since solution market prices still exceeded the loan rate. Under liberalization, net government demand for agricultural products is set at the level observed in 1982 when carryover stocking was relatively low.

The net improvement in the government budget deficit results in 5.2 percent more savings and investment. Investment demand consists largely of residential construction and demand for capital goods (machinery, etc.). The increased demand for construction and capital goods is met by increased employment of capital and labor in both sectors, increased output, and almost no change in domestic prices. Output in the construction and capital goods sectors increases by 3.2 and 2.6 percent, respectively (table 8.7).

Labor and capital move into the construction and capital goods sectors from the agricultural sectors. With the release of factors of production from agriculture, economywide wages and average returns to capital both fall by about half of a percent. Since agriculture is a very small employer of resources, even major changes in the marginal value product in agriculture on the economywide wage/rental ratio is likely to be small. On the other hand, the returns to land (used only in agriculture) fall 18.6 percent with the removal of agricultural subsidies (table 8.6).[26]

In this experiment we assume no world agricultural price response or reaction by the rest of the world to liberalization in U.S. agriculture, so world prices remain artificially low. Hence, the United States appears to be less competitive in world agricultural markets—agricultural exports fall and imports increase.[27] Thus, the balance of trade deteriorates by $16.7 billion, largely because the contribution of the agricultural sectors to net exports falls by $15.4 billion. Increased net imports of light consumer goods (processed dairy products, animal feeds, textiles) account for the rest of the deterioration in the trade balance (table 8.5). With the increase in domestic agricultural prices, domestic output for this sector is priced higher than the substitutable import.

Removing the subsidies without relaxing the acreage constraints reduces income in the agricultural sectors, particularly the export dependent grains sector. Without the export subsidies and high level of domestic supply, grains export volume falls to 52 percent of the level in 1986 and is 57 percent lower than the base projection to 1991 with programs intact. Imports of grains increase because of the 60 percent increase in the relative price of domestic to imported grain. Imports of dairy and meat products triple with the relaxation of the quota constraints, and dairy and meat exports fall 16.1 relative to the 1991 level (table 8.6).

The light consumer goods sector, in which the processing of agricultural products takes place, again suffers along with the agricultural sectors, with output falling by 2.1 percent against the 1991 base run. Given the size of the sector, this decline is significant. Exports also fall by 6.4 percent and imports also increase as import quotas are relaxed and the domestic price increases 2.2 percent against the world price (table 8.7).

The net impact of this experiment is a deterioration in the trade balance to accommodate a $22.5 billion increase in total absorption. This lost export income results in $16.4 billion lower farm income (the sum of income in the dairy and meat, grains, and other agriculture sectors). This result suggests that unilateral liberalization would jeopardize the U.S. trade balance, with negative economywide as well as sectoral consequences. Unfortunately, as the results of the next experiment show, these undesirable results obtain even if the constraints on land in agriculture are relaxed.

Experiment 5: Unilateral Liberalization

The experiments above analyzed the impact of removing parts of the U.S. farm programs. This experiment represents complete unilateral liberalization. All programs that distort returns to production and/or constrain input use are removed. Constraints on land use are relaxed, as in the "Land" experiment; border measures are removed, as in "Border"; and domestic programs are dismantled, as in "Domestic." Thus, this experiment is the sum of all previous experiments, but the general equilibrium results are not simply the sum of the component experiment results.

With neither the constraints nor the subsidies, land use in agriculture increases by 4.7 percent overall (1.1 percent in grains, 17.0 percent in other agriculture). Compare these to the results of the "Land" experiment, where land use increased nearly 16.0 percent. Even more capital and labor leaves the farm sector as land is substituted for the other factors. The use value of land also falls 25.6 percent against the 1991 base rate of return.[28] Output and exports of grains nevertheless increase marginally. Complete unilateral dismantling of U.S. farm programs, even without assuming an impact on world import prices, results in a $9.6 billion increase in GNP.

The effects on factor employment, output, trade, and income in the nonagricultural sectors of this experiment are parallel to the results reported for experiment 4. There is a $15.6 billion deterioration in the balance of trade, a $26.1 billion reduction in the government budget deficit, and a $35.7 billion increase in investment. The construction and capital good sectors also expand. Absorption is $24.4 billion higher than the subsidy-ridden 1991 level. Again, these increases contrast with agriculture's losses. Net agricultural exports fall almost to zero, and farm income falls by $20.6 billion (tables 8.5 and 8.8).

Experiment 6: Multilateral Liberalization

While this is not a multicountry model, it is perfectly suitable for analyzing the domestic impact of changes in conditions on world markets. This is done by resolving the model with respect to the new world market prices of importables and substitutes for U.S. exports. In the sixth experiment, "Multilateral," we assume increases in the world prices of competing agricultural goods in addition to the program removal elements of the previous "Unilateral" experiment. It is designed to represent multilateral agricultural liberalization. The increase in world prices of competing agricultural goods is assumed to result from a decline in exportable supplies worldwide and an increase in world demand arising from a relaxation of import quotas.

We assume an 11.1 percent increase in the world price of dairy and meat, and increases of 42.9 and 3.1 percent for grains and other agriculture goods, respectively. These rates of increase relative to 1986 represent zero increases relative to 1982 prices in each sector. Roningen, Sullivan, and Wainio (1987) estimate increases of about 21, 8, and 3 percent, respectively, relative to 1984 prices (which translate into much higher increases relative to the actual, and lower, 1986 prices); while Tyers and Anderson's dynamic, partial equilibrium, multicountry model estimates initial increases in international food prices of about 20 percent owing to liberalization in all markets other than the United States, and ultimate increases of another third by 1995.[29] Demand for U.S. agricultural exports depends on the difference between the U.S. agricultural export price and the price of substitutes in world markets. In the analysis of multilateral agricultural trade liberalization, it is assumed that the world prices of imports and substitute export agricultural goods equalize. The price of U.S. exports is then determined endogenously and simultaneously with the volume of U.S. agricultural exports.

An overall average price of tradable agricultural goods in world markets is calculated as the weighted average of the U.S. export price and the world price of substitutes, the weights being the shares of U.S. exports in world markets.[30] Thus, the changes in international prices resulting from our "Multilateral" experiment are found to be increases of 11 percent in dairy and meat, 23 percent in grains, and 3 percent in other agriculture (results not tabulated).

The near $26 billion in government budget deficit reduction allows savings and investment increases of 1.4 percent. The trade deficit also reduces by $4.8 billion, and foreign saving in the United States goes down by $10.6 billion. Real GNP increases by $9 billion. Otherwise, multilateral liberalization, if it does indeed result in world agricultural prices regaining their 1982 levels in real terms, results in a picture of nonagricultural output, income, and employment that is very similar to the base-run projection. Overall, the economywide average wage is lowered by .4 percent.

On the other hand, there are substantial differences in the structure of agriculture. The increase in world prices stimulates production for export, especially in the grains sector. Land in agriculture increases by 15.5 percent in grains and 9.3 percent in other agriculture over the base-run projection under the programs (table 8.6). Labor and capital also move into the grains sector, so that grains output increases by almost 12 percent. Of this additional output, 65 percent is exported. Agriculture's contribution to the balance of trade increases by $5 billion (tables 8.5 and 8.6).

This type of expansion is not observed in the dairy and meat or other agriculture sectors, because those sectors were not competitive export sectors in the first place. Labor moves out of those sectors and output is down accordingly, relative to the protected 1991 result. Sector income is down the most in dairy and meat, somewhat in other agriculture, while it is slightly higher in the grains sector.

The fate of the light consumer goods sector, as in the other exercises, is shown to be linked to agriculture. Production and exports are lower, and imports are higher, than in the protected 1991 base run. The higher domestic prices of the raw agricultural products and the relaxation of import quotas squeeze net returns to the light consumer good-processing sector.

Experiment 7: Elasticities of Response to World Prices

While we cannot be sure about the exact change in prices due to multilateral liberalization in world markets for agricultural goods, we can determine if the qualitative results are robust with respect to general changes in world agricultural prices. The following experiments provide qualitative information about the response of domestic market prices, output, employment, and trade, to changes in the world prices of agricultural goods. In particular, we numerically compute the elasticities of these economic variables with respect to world agricultural prices. First, one-by-one elasticities are computed. Then, we find the percent change in the variables due to simultaneous 1 percent changes in all three world agricultural prices. The results are presented in table 8.9.

The results should be considered in light of the results of unilateral liberalization as well as with respect to the base scenario. As discussed earlier, domestic market-clearing prices in the three agricultural sectors increase following liberalization. The increase in prices occurs because fewer resources are devoted to agriculture when subsidies are discontinued, so that output falls while consumption stays relatively constant. Thus, the market-clearing

Table 8.9 Elasticities of Sector Responses to World Agricultural Prices

Sector	PVA	Consumer price	World price (U.S.)	Sector income	Output	Exports	Imports
Increase world dairy price							
Dairy	0.0	2.2	82.9	7.5	7.5	48.1	−310.7
Grains	1.3	0.8	0.1	4.0	2.7	−0.2	6.3
Other	0.9	0.5	0.3	0.7	−0.2	−0.8	2.2
Ltcons	−0.0	0.3	0.0	−0.2	−0.1	−0.7	0.6
Basint	−0.0	0.0	0.0	−0.1	−0.1	−0.1	−0.1
Kgood	−0.1	0.0	0.0	−0.4	−0.3	−0.3	−0.3
Constr	−0.0	0.0	0.0	−0.5	−0.4	−0.4	0.0
Elec	−0.1	−0.0	0.0	−0.2	−0.2	−0.2	−0.2
Trade	−0.0	−0.0	0.0	−0.1	−0.0	−0.0	0.0
Serv	−0.0	0.0	0.0	−0.0	−0.0	−0.0	−0.0
Increase world grain price							
Dairy	0.1	0.3	−0.0	0.3	0.3	0.1	1.4
Grains	9.0	0.4	41.4	27.8	18.7	178.3	−315.3
Other	6.1	3.2	2.0	3.5	−2.6	−5.8	12.2
Ltcons	−0.0	0.2	0.0	−0.2	−0.2	−0.5	0.1
Basint	0.0	0.0	0.0	−0.1	−0.1	−0.1	−0.1
Kgood	−0.1	−0.0	0.0	−0.9	−0.9	−0.8	−0.9
Constr	−0.1	−0.0	0.0	−1.3	−1.3	−1.3	0.0
Elec	−0.1	−0.0	0.0	−0.5	−0.4	−0.4	−0.4
Trade	−0.0	−0.0	0.0	−0.1	−0.1	−0.0	0.0
Serv	0.0	0.0	0.0	−0.0	−0.0	−0.0	−0.0
Increase world other agricultural price							
Dairy	−0.1	1.8	0.5	−0.8	−0.7	−1.4	6.6
Grains	7.4	4.3	2.6	6.1	−1.3	−7.6	16.7
Other	5.0	13.2	50.5	53.4	48.1	148.1	−282.6
Ltcons	−0.1	0.8	0.0	−1.0	−0.9	−2.5	0.9
Basint	−0.1	−0.0	0.0	−0.5	−0.4	−0.4	−0.4
Kgood	−0.1	−0.0	0.0	−1.7	−1.6	−1.5	−1.6
Constr	−0.1	0.0	0.0	2.3	−2.2	−2.2	0.0
Elec	−0.1	−0.0	0.0	−1.0	−0.9	−0.9	−0.9
Trade	−0.1	−0.0	0.0	−0.4	−0.3	−0.2	0.0
Serv	−0.1	−0.0	0.0	−0.2	−0.1	−0.1	−0.1
Increase all world agricultural prices							
Dairy	0.0	4.3	83.4	7.0	7.0	46.7	−305.1
Grains	17.7	5.5	44.2	38.0	19.9	169.2	−299.4
Other	11.9	17.0	52.7	58.2	45.8	140.9	−271.9
Ltcons	−0.2	1.3	−1.4	−1.3	−3.8	1.6	0.0
Basint	−0.1	0.0	−0.7	−0.6	−0.6	−0.6	0.0
Kgood	−0.2	−0.1	−3.0	−2.7	−2.6	−2.8	0.0
Constr	−0.2	0.1	−4.1	−3.9	−4.0	0.0	0.0
Elec	−0.2	−0.0	−1.7	−1.5	−1.4	−1.5	0.0

Table 8.9 continued

Sector	PVA	Consumer price	World price (U.S.)	Sector income	Output	Exports	Imports
Trade	−0.2	−0.1	−0.5	−0.3	−0.3	0.0	0.0
Serv	−0.1	0.0	−0.3	−0.2	−0.2	−0.2	0.0

Note: The "elasticity" is the percent change in the column variable due to a one percent change in the price (or prices) in the rest of the world, as indicated, multiplied by 100.

prices rise when subsidies are removed. Where domestic prices are supported by the existence of quotas against imports, since the share of these imports in consumption is small, the price-depressing effects of lower-priced substitutes are outweighed by the price-increasing effects of reduced domestic supplies, and these domestic prices rise also. If world market prices rise in addition, domestic prices rise even further.

The observed effect on domestic prices of increases in world prices is thus to raise them, but not by 100 percent, since the importable, the exportable, and the good for domestic consumption are imperfect substitutes. Since foreign and domestic versions of dairy and meat are fairly substitutable, the U.S. export price of dairy and meat increases 0.83 percent for every 1 percent increase in the price of dairy and meat from the rest of the world. The U.S. export price of grains increases 0.41 percent for every 1 percent increase in the world price of grain. This reflects the lower substitutability between domestic and foreign grain, which is more likely due to the political distinctions between sources of grain which lead to stabilized market shares than to physical differences among the actual products. The U.S. export prices of other agricultural goods increase by 0.5 percent for each 1 percent increase in world prices. Again, the other agricultural goods exported by the United States (temperate fruits, nuts, and seeds) are not easily substituted for the imports (tropical fruits, coffee, vegetables in season).

The prices faced by U.S. consumers are also positively related to world market prices, but since imported goods comprise such a small portion of the consumption basket, these increases are negligible in the first two agricultural sectors and marginal in the other agricultural good sector. The price consumers pay for the composite other agricultural good increases .13 percent for every 1 percent increase in the world price.

The elasticities of U.S. export supply with respect to world market price increases are between .48 for dairy and meat and 1.78 for grains. The elasticity for dairy and meat is lowest because production in this sector is largely for domestic consumption. For each 1 percent increase in the world price of grain, the United States increases grain exports by 1.78 percent. Likewise, for each 1 percent increase in the world price of other agricultural goods, U.S. other exports increase by 1.48 percent.

With producer prices rising, and export volumes increasing, resources are drawn back into the agricultural sectors relative to unilateral liberalization. The elasticity of the "resource pull" effects of world price increases under multilateral liberalization are indicated by the elasticities of the value added price (PVA). In each of the elasticity experiments, the agricultural sectors show an increased resource pull at the expense of the nonagricultural sectors. Thus, the qualitative impact of multilateral agricultural liberalization on resource allocation in the United States is to offset the tendency for resources to move out of agriculture.

Winners and Losers

Table 8.8 shows the changes in sectoral income and aggregate value added (GNP at factor cost) arising from the experiments. In general, the removal of agricultural subsidies hurts agricultural income: it falls as much as 19 percent under the subsidy removal experiments ("Border," "All subsidies," "Unilateral," and "Multilateral"). Aggregate farm income will be lower without the current farm programs; under the "Multilateral" liberalization experiment it is 4.4 percent lower (or $4.8 billion lower) than the 1991 base run. But labor and capital also move out of agriculture, so that farm income per unit of farm labor actually increases, albeit imperceptibly, by .76 percent. Aggregate income in the nonfarm economy also falls, but even less perceptibly: nonagricultural income by either measure falls only .44 percent under the "Multilateral" scenario.

The total value of the subsidies is $34.7 billion (in the 1991 base run), but their removal only leads to declines in agricultural incomes of $5 to $21 billion between the "Multilateral" and the "Unilateral" experiments. Thus, when market distortions are removed multilaterally, it would cost the government only $4.8 billion dollars of pure transfers to guarantee the farm sector an income comparable to the 1991 base run level.

A large portion of the lost subsidy is also shared with the nonagricultural sectors. The sectors directly linked to agriculture (light consumer, trade and finance, and other services) are most affected. The construction and capital goods industries are also affected indirectly, owing to the increase in savings

Appendix: Sector Aggregation

Sector	Industries (major)	BEA industry classification
Dairy and meat	Milk, eggs, meat animals, poultry	1.01–1.03
Grains	Wheat, corn, rice, soy, cotton, peanuts, flax	2.01, 2.0201–2.0203, 2.06
Other agriculture	Sugar, tobacco, fruits, vegetables, nuts, other	2.03, 2.04–2.0503, 2.07, 3.0, 4.0
Light consumer	Food and kindred products, leather, footwear, textiles, apparel, furniture containers, printing	14–25, 32–33
Basic intermediates	Mining, petroleum, chemicals, plastic, rubber, glass and stone, iron and steel, fabricated metals	5–10, 27–32, 35–42
Capital goods	Munitions, engines, machinery, communications, trucks, motor vehicles	13, 43–50, 56.03, 56.04, 57.03, 59–61
Construction	Private and government construction	11–12
Electronics	Office equipment, household appliances, semiconductors, equipment, misc. electronics, TV, radio and other industry	51, 57–57.02, 58, 62–64, 81, 84–85
Trade	Wholesale and retail trade, banking and insurance	69–70
Services	Real estate, services, government, noncomparable imports	65–68, 71–79, 80

Note: BEA industry classification from Appendix B: "Industry Classification of the 1977 Input-Output Tables," U.S. Department of Commerce, *Survey of current business* (May 1984), 80.

following the reduction in the federal deficit. Thus, the loss of $34.7 billion of agricultural subsidies, with at least $10 billion of additional income arising from the more efficient allocation of resources, ultimately amounts to only a $24.7 billion decrease in overall sectoral income.

Although aggregate sectoral income falls in all subsidy removal experiments, it is important to note the distinction between net sectoral income (which includes subsidies) and sectoral value added (or GNP at factor cost, which does not include subsidies). In the experiments, sectoral incomes fall because the policy reform diverts income away from the accounts of producers and gives it back to the government. In terms of the GNP accounts, however, these subsidies are treated as nonproductive transfers. Total value added, or GNP, rises significantly in all experiments (except the "Border" experiment where the increase is tiny). The removal of a distortion should lead to an increase in efficiency and, hence, in GNP. Our experimental results indicate that this is indeed the case.

Notes

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1. For an analysis of these linkages, see Henry and Schluter (1985).

2. The value of EEP bonuses for "dairy and meat" and "other agriculture" was calculated from FAS press releases for calendar year 1986. The EEP for "grains" was provided by Mark Smith at Economic Research Service, U.S. Department of Agriculture (ERS).

3. For participation rates for the years 1983 through 1987, see U.S. Department of Agriculture, *Agricultural Outlook* 139 (March 1988): 48 (table 22).

4. The predetermined output is calculated as the five-year moving average yield per acre times the "program" acreage. The "program" acreage is the amount of land that the farmer has previously planted to program crops, which he has certified to be part of the base acreage. The "program" acreage includes the land set aside (not currently in production of program crops) as well as planted acreage. See Glaser (1986).

5. For an exemplary analysis, see Houck et al. (1976).

6. For further discussion of PIE and PSE rates, see Rausser and Wright (1987); Josling and Tangermann (1987); and Tangermann, Josling, and Pearson (1987).

7. The rates of PSE subsidies were calculated by an ERS team using similar data from different sources. See also U.S. Department of Agriculture (1987).

8. Our particular model is an extension of the model by Adelman and Robinson (1987). It is close in spirit to the model described in Condon, Robinson, and Urata (1985). Related models are discussed in Dervis, de Melo, and Robinson (1982) and Robinson (1989).

9. See appendix for the industry composition of sectors in the model.

10. The land supply equation is similar in content to the land supply equations in the model AGSIM at the University of Illinois (Taylor 1988). Estimated elasticities of regional land supply with respect to expected productive returns to land range from 0.06 to 8.89. We assume a 0.5 elasticity of land supply with respect to the relative productive return to land. With this elasticity, the acreage restrictions (on land in crops while subsidy programs are operative) reduce land in crops by about 16 percent, which is close to the required cropland set-aside rate under the 1985 Farm Bill.

11. For a discussion of the implications of the Cobb-Douglas model, see Hertel (1988).

12. Estimates of the price elasticities of world demand for U.S. agricultural exports are based on an examination of a number of econometric studies. Given the medium-

to-long-run focus of our analysis, we have sought estimates of long-run demand elasticities. The export demand elasticities for both grains and other agriculture are assumed to equal 3.0.

13. U.S. Department of Commerce (1986).

14. Houck (1986).

15. This treatment follows Armington (1969).

16. For a description of this treatment in a CGE model, see Condon, Robinson, and Urata (1985).

17. This choice of numeraire differs from Adelman and Robinson (1987), who chose as numeraire an index of the price of domestically produced goods sold on the domestic market. They fixed this index at one for all their experiments.

18. See Dervis, de Melo, and Robinson (1982), chapter 7, for a discussion of this issue. See also de Melo and Robinson (1987).

19. Aggregate expenditure on goods is fixed in real terms, with sectorally fixed shares. Aggregate transfers are also fixed in real terms, using the GNP deflator to deflate nominal transfers.

20. Note that the model is static in the sense that this investment is not installed and has no effect on the aggregate capital stock within the period.

21. The data are from a model solution for 1986. The model starts from a 1982 benchmark equilibrium and the 1986 solution was calibrated to match the national accounts for 1986 as closely as possible. The fit, however, is not exact; the model was not "recalibrated" on 1986.

22. Note that as far as the model results are concerned, it does not matter much whether the government deficit is removed by decreased expenditure or increased taxes.

23. See Adelman and Robinson (1988).

24. In 1986, the secretary of agriculture announced that over $47 million dollars worth of export enhancement program bonuses were awarded. This amounts to only .18 percent of the value of 1986 agricultural exports. On the other hand, U.S. sugar programs supported domestic prices at 3.4 times the 1986 world market price for sugar (Barry and Angelo 1988).

25. There are also minor revenue changes as the structure of the economy changes.

26. This result is sensitive to our specification of production technology in the three sectors. If capital and labor were assumed to be less substitutable with land, the output adjustment would be lower and the price increase would be smaller.

27. Also, although the nominal exchange rate is held constant in the experiment at the 1991 solution level, there is a very slight increase in the real exchange rate. It increases by .18 percent.

28. Again, these results are sensitive to the specification of agricultural production technology.

29. Tyers and Anderson (1987), page 23.

30. U.S. weights are calculated from market share data in table 2.1 of Tyers and Anderson (1987).

References

Adelman, I., and S. Robinson. 1988. Macroeconomic shocks, foreign trade, and structural adjustment: A general equilibrium analysis of the U.S. economy, 1982–1986. In *Elasticities in International Trade*, ed. C. Carter and W. Gardiner. Boulder, Colo.: Westview Press.

Armington, P. 1969. A theory of demand for products distinguished by place of production. *IMF Staff Papers*. 16:159–78.

Barry, R. D., and L. Angelo. 1988. U.S. Sugar programs and program operations, 1977–1987. In *Sugar and sweetener situation and outlook*. U.S. Department of Agriculture, Economic Research Service.

Condon, T., S. Robinson, and S. Urata. 1985. Coping with a foreign exchange crisis: A general equilibrium model of alternative adjustment mechanisms. *Mathematical Programming Study*, no. 23: 75–94.

Council of Economic Advisers. 1987. *Economic report of the president*. Washington, D.C.: U.S. Government Printing Office.

de Melo, J., and S. Robinson. 1987. The treatment of foreign trade in computable general equilibrium models of small economies. World Bank. Mimeo.

Denison, E. F. 1967. *Why growth rates differ*. Washington, D.C.: Brookings Institution.

Dervis, K., J. de Melo, and S. Robinson. 1982. *General equilibrium models for development policy*. New York: Cambridge Univ. Press.

Dunham, D. 1987. *Food cost review, 1986*. U.S. Department of Agriculture, Economic Research Service, Agricultural Economics Report no. 574.

Glaser, L. K. 1986. *Provisions of the Food Security Act of 1985*. U.S. Department of Agriculture, Economic Research Service, Agriculture Information Bulletin no. 498. Washington, D.C.

Henry, M., and Schluter, G. 1985. Measuring backward and forward linkages in the U.S. food and fiber system. *Agricultural Economics Research* 37(4):33–39.

Hertel, T. 1988. General equilibrium incidence of natural resource subsidies: The three factor case. *Journal of Environmental Economics and Management* 15(2): 206–23.

Houck, J. 1986. Market structure, policy, and behavior in world grain and soybean markets. In *Embargoes, surplus disposal and U.S. agriculture*, U.S. Department of Agriculture, Economic Research Service, Agricultural Economic Report no. 564. Washington, D.C.

Houck, J. P., M. Abel, M. Ryan, P. Gallagher, R. Hoffman, and J. B. Penn. 1976. *Analyzing the impact of government programs on crop acreage*. U.S. Department of Agriculture, Economic Research Service, Technical Bulletin no. 1548. Washington, D.C.

Josling, T., and S. Tangermann. 1987. Quantitative measures for negotiating and monitoring trade liberalization in agriculture. Paper presented to the International Agricultural Trade Research Consortium Meeting, November, Airlie House, Virginia.

Monaco, R. 1987. TGM (Trend Growth Model) description. U.S. Department of Agriculture, Economic Research Service. Mimeo.

Rausser, G., and B. Wright. 1987. Alternative strategies for trade policy reform.

Working Paper prepared for the Benjamin E. Lippincott Symposium on Policy Co-ordination in World Agriculture, April 22–24, University of Minnesota.

Robinson, S. 1989. Multisectoral models: A survey. In *Handbook of development economics*, vol. 2, ed. H. B. Chenery and T. N. Srinivasan. Amsterdam: North-Holland Publishing Co.

Roningen, V. 1986. *A static world policy simulation (SWOPSIM) modelling framework.* U.S. Department of Agriculture, Economic Research Service Staff Report no. AGES860625. Washington, D.C.

Roningen, V., J. Sullivan, and J. Wainio. 1987. The impact of the removal of support to agriculture in developed countries. Paper presented at the American Agricultural Economics Association Meetings, August 1987, East Lansing, Michigan.

Salathe, L. E., J. M. Price, and K. E. Gadson. 1982. The food and agricultural policy simulator. *Agricultural Economics Research* 34(2):1–15.

Tangermann, S., T. Josling, and S. Pearson. 1987. International negotiations on farm support levels: The role of PSEs. Institute for Agricultural Economics and Food Research Institute, Stanford University. Mimeo.

Taylor, C. R. 1988. *AGSIM: The crop supply component.* U.S. Department of Agriculture, Economic Research Service Staff Report. Washington, D.C.

Tyers, R., and K. Anderson. 1987. Liberalising OECD agricultural policies in the Uruguay Round: Effects on trade and welfare. Australian National University, Working Papers in Trade and Development no. 87/10. Canberra.

U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service. 1987. Commodity Credit Corporation mid-session review. Washington, D.C. Mimeo.

U.S. Department of Agriculture, Agricultural Statistics Board. 1987. *Agricultural prices: 1986 summary,* Pr1-3(87). Washington, D.C.

U.S. Department of Agriculture, Economic Research Service. 1987. *Financial characteristics of U.S. farms, January 1, 1987.* USDA, ERS Agriculture Information Bulletin no. 525. Washington, D.C.

———. 1987. *Government intervention in agriculture: Measurement, evaluation, and implications for trade negotiations.* Foreign Agricultural Economic Report no. 229 (April). Washington, D.C.

U.S. Department of Commerce, Bureau of Economic Analysis. 1986. *Survey of current business.* Washington, D.C.

9. Economywide Effects of Unilateral Trade and Policy Liberalization in U.S. Agriculture

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Summary

During the 1980s U.S. farm program expenditures have grown very rapidly. In recent years the cost of price and income supports has come close to $30 billion per year. This growth has occurred at a time of increasing budget austerity and has prompted debate about the economywide effects of these farm programs. There is little doubt that they significantly alter the allocation of resources, both within the farm economy and between the farm and nonfarm sectors. This study measures the magnitude of these economywide effects.

The vehicle for this analysis is a general equilibrium model of the U.S. economy. It places primary emphasis on the farm and food system which is modeled in considerable detail. Recent econometric evidence is combined with information from the input-output tables, the national income and product accounts, and a variety of recent studies of taxation and agricultural policy. Standard assumptions about economic behavior and market clearing are made, and the model is used to simulate the effects of removing those agricultural policies in place in 1984. However, in keeping with important changes implemented in the 1985 Farm Bill, the United States is no longer assumed to support world grain prices at the loan rate.

The results indicate that there are substantial nonfarm costs to supporting U.S. agriculture with the current configuration of policies. These costs include

the following (measured in 1987 dollars and expressed in terms of farm jobs saved by current policies):

1. reduced nonfood output (−$107,000/year per farm job saved)
2. increased treasury outlays ($80,500/year per farm job saved)
3. lower real domestic income (−$28,700/year per farm job saved)

Unilateral liberalization of U.S. agriculture results in short-run losses to the landowners, labor, and capital employed in agriculture. (These would be considerably dampened if other countries were to join suit and reduce agricultural support levels.) In the long run, capital and labor leave agriculture to higher productivity employment in nonfarm activities. As a result, farmland rents drop even further and food prices rise considerably. The capitalized value of landowners' losses (at a 5 percent real interest rate) equals $113.8 billion. Compensation for these losses, as well as adjustment assistance for farm labor and capital owners, can be more than covered out of the increased treasury revenues generated by the policy changes. In fact, in the long run a domestic surplus of $5 billion per year is generated because of a more efficient allocation of resources in the U.S. economy.

Introduction

There is a long history of federal government involvement in U.S. agriculture. Current farm programs date back to 1933 when the Commodity Credit Corporation (CCC) was set up to implement a set of price and income support measures designed to save farmers from bankruptcy. Since that time the nature of American farming has changed dramatically. So, too, have conditions in the world marketplace. While net farm income and government program costs vary widely from year to year, there has been an upward trend in the 1980s which appears unsustainable. Expenditures on farm programs have grown three times as fast as defense expenditures. Annual CCC outlays in recent years have reached nearly $30 billion. This budget growth has occurred at a time of increasing fiscal austerity. It has motivated many policymakers to ask whether these costs can be reduced, and what the implications of such cuts might be.

The current mix of farm programs is quite complex (Council of Economic Advisers 1984 and 1986). By and large they are directed at reducing production costs and enhancing producer commodity prices in order to bolster farm incomes. When domestic consumer prices are also maintained at levels above world prices, border measures such as tariffs, quotas, or other nontariff barriers are required in order to validate the domestic policy. The most striking example of this in recent years has been that of the sugar program. The import quota on sugar has been continually tightened in order to maintain legislated support prices at levels occasionally exceeding the world market price by 700 percent! Because of these interactions, domestic and trade policies affecting U.S. agriculture must be examined in combination with one another.

The presence of extensive government intervention in agriculture brings with it real costs. Recent estimates of the resulting net economic cost to society (i.e., consumer and taxpayer costs, less producer gains) totaled between $6 billion and $7 billion (Council of Economic Advisers 1986). More specifically, price supports and input subsidies have tended to encourage excessive use of scarce resources in agriculture. As a result, many nonagricultural sectors have been implicitly penalized by these farm programs. The objective of this paper is to measure these economywide effects associated with U.S. agricultural policies.

Background

In order to put the current situation in proper perspective, it is useful to reconstruct some of the recent events leading up to the current farm budget crisis. During the decade of the 1970s, grain production in the rest of the world grew at about 24 million tons a year. This was outstripped by global consumption which was growing at the annual rate of 34 million tons. U.S. farmers stepped in to fill this production deficit and the value of U.S. farm exports increased more than fivefold over this decade. The percentage of farm receipts coming from exports increased from less than 15 percent to more than 30 percent. U.S. producers met this increased demand by expanding planted acreage, investing in additional equipment, and intensifying the use of purchased inputs.

In the 1980s this situation changed dramatically. A global recession slowed the growth in grain consumption to 19 million tons per year. Meanwhile the rate of increase in global grain production had risen to 29 million tons a year. Rather than a 10 million ton deficit, a 10 million ton surplus was accumulating annually. Rather than responding to this global glut in the grain market by reducing prices, the United States chose to maintain the high support prices legislated in the 1981 Farm Bill. As the dollar appreciated in value, these support prices became more and more out of line with world market conditions. By 1983 grain stocks had built up to the point where further production restraints were necessary. In that year almost 80 million acres of farmland were taken out of production, much of this in exchange for payment-in-kind (PIK) commodities designed to reduce government held stocks. Total payments to farmers amounted to $28 billion, which actually exceeded net farm income earned in that year.

While farmers were compensated for their reduced production levels, the 1983 PIK program had a devastating impact on the farm-related economy. This served to highlight how interdependent the U.S. farm and nonfarm economies have become. Farmers spend almost half their gross income on purchased inputs. Fifty-eight percent of these are produced in the nonfarm sector. In addition, after the food products leave the farm, food processing, transportation, and marketing activities generate almost five times as many jobs as does production agriculture. Thus, when farm production levels were curtailed in 1983, these input supply and marketing sectors experienced sharp reductions in output and employment.

As the decade progressed, farm exports continued to fall, largely as a result of the high U.S. support price and the appreciating dollar. By 1985–86 they had dropped, from a high of $44 billion in 1981, down to $26 billion. It was in this environment that the 1985 Farm Bill was written. In an effort to rectify past mistakes, loan rates were cut dramatically. It was hoped that this would stimulate exports and reduce the buildup of stocks. However, with target prices unchanged, this has resulted in very high budget costs (e.g., $26 billion in fiscal year 1986). In an effort to contain these government expenditures, set-aside requirements have been increased. Also, there has been considerable interest in extending the Conservation Reserve Program which is already intended to take 40 million acres of erosive land out of production by 1990.

With these massive government interventions in U.S. agriculture it is no longer possible to assess their combined impact by looking at the sum of the individual commodity market effects. Nor is it even adequate to analyze the farm sector as a whole. The budgetary, trade, consumption, and factor market effects of current farm programs are potentially large enough to have an impact on the entire economy. In order to assess these effects a general equilibrium model of the U.S. economy is utilized. It is specifically designed to assess the economywide effects of liberalizing agricultural policies.

Overview of a United States CGE Model with an Agricultural Emphasis

Figure 9.1 portrays the circular commodity flows in the computable general equilibrium (CGE) model used in this study. Crop and livestock farms (see bottom of figure) are highlighted. They rent primary input services (land, labor, and capital) from the private domestic household. These are combined with intermediate inputs (both domestic and imported) to produce farm products. Commodities also flow from the six crop sectors to the three livestock sectors, in part via the prepared-feeds industry.

Raw farm products pass through the rest of the economy, generally receiving some additional value added, before being sold to domestic households or exported. These food products compete with nonfood commodities and imports in the product markets. (See appendix A for a complete listing of the forty-one productive sectors included in this model.) The agricultural sectors also compete with nonfarm firms in the factor markets.

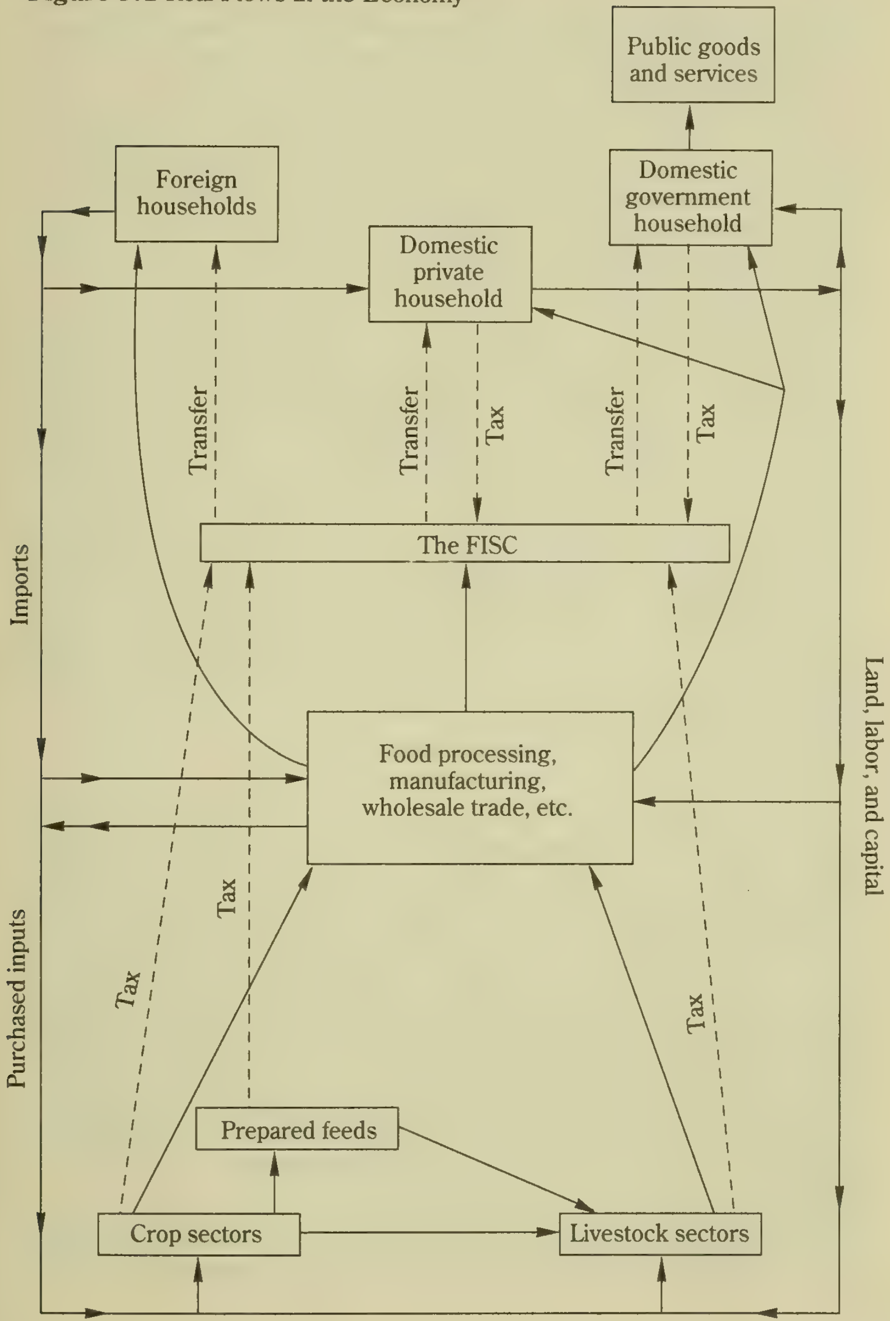
Government functions are divided into two components (Keller 1980). The first involves the provision of public goods and services by the government "household." Since these products are assumed nonrival in consumption, their demands are not explicitly modeled. (However, their supply can be measured by real government outlays on private goods and services which are endogenously determined.) Treasury activities are handled by the "fisc," which collects all tax revenues from product and factor market transactions. (Subsidies are simply negative taxes.) These revenues are then distributed to the government, private, and foreign households. Any deficit financing is handled by a lump sum tax on, negative transfer to, the relevant households.

Model Specification

Expenditures in Initial Equilibrium

A detailed discussion of the model's specification is provided in appendix B. Two types of information are required. The first relates to expenditures by all firms and households, corresponding to the arrows in figure 9.1 (for some benchmark period). These are based on the U.S. input-output table and the national income and product accounts. The initial policy environment, as summarized by the taxes, subsidies, and transfers shown in figure 9.1, must also be specified. Policy distortions are modeled as ad valorem price wedges. These are obtained from a variety of studies (see appendix B). Since the

Figure 9.1 Real Flows in the Economy



most recent set of model consistent tax rates on capital, labor, output, and consumption applies to the year 1984 (Boyd 1988), this was selected as the base year for the liberalization experiments. Thus agricultural policy and trade distortions in the model are also based on 1984 subsidy levels. While support levels have risen in recent years, they are now falling with recent increases in world prices and U.S. farm exports. Thus 1984 subsidy levels may be more indicative of those observed in the next couple of years. However, in order to be applicable in the post-1985 Farm Bill environment, we assume (unlike 1984) that the U.S. loan rate does not support the world price for program crops.

A detailed discussion of the treatment of agricultural programs is provided in appendix B. This treatment is quite extensive. Dairy and sugar programs are introduced as a domestic/world price differential. Set-aside requirements for grains and cotton serve to shift these supply curves backwards, while output subsidies encourage producers to move further up their program supply curves. These output subsidies include deficiency and disaster payments, crop insurance subsidies, as well as other subsidies explicitly tied to the amount of program crop output produced. The provision of low cost capital to agriculture via the Farmer's Home Administration and the Farm Credit System is captured in the form of capital subsidies. Similarly, subsidies on land improvements as well as grazing are treated as input subsidies to the relevant farm sectors.

Marginal Behavior in the Model

The second type of information required to specify the CGE model used in this study is that which describes the behavior of firms and households in the economy. All firms are assumed to maximize profits subject to a production function. (In competitive equilibrium, this means that they will be operating in an area of locally constant returns to scale.) Households are assumed to maximize utility subject to a budget constraint. However, the observed potential for substitution among inputs and among consumption goods differs considerably across firms and among households. In an effort to capture these differences, different marginal behavior, i.e., different price and income elasticities, are specified. This is an important point and deserves further elaboration.

Input substitution possibilities in the nine farm sectors are based on econometric evidence for aggregate U.S. agriculture (see appendix B). Seven distinct input groups are identified, including land, labor, two different types of capital, feed, chemicals, and other inputs. In addition, further substitution within the feed aggregate is permitted. Prepared feeds substitute for the on farm feed mix, where the latter consists of a (price sensitive) combination of feed grains and soy meal.

The distinguishing feature between prepared feeds and the on farm feed mix lies in the prepared feeds sector's greater access to feed ingredients. As the price of soy meal increases, it may be desirable to bring in small amounts of fish meal, for example. Incorporating alternative ingredients may only be feasible if a very large amount of feed is being prepared. There are three prepared feeds sectors, one for each type of livestock in the model (dairy, poultry, and red meats). These sectors each exhibit differing elasticities of substitution between food and feed grains, between soy meal and other sources of protein, and between the grain and protein aggregates. These are implicitly determined by the nutrient requirements of these three livestock groups.

Given the nature of the liberalization experiments conducted below, less detail is required in the nonfarm production functions. Capital-labor substitution is dictated by a constant elasticity which varies across sectors. Intermediate inputs are assumed to be employed in fixed proportion to the output level in each nonfarm sector.

The total availability of capital and labor is held fixed in order to highlight the competition between farm and nonfarm sectors for scarce domestic resources. The total supply of agricultural land is also constant. However, acreage supplied to individual crop and grazing uses is responsive to changes in relative rental rates.[1] For example, holding all other prices constant (and abstracting from acreage controls), a 10 percent increase in the price of feed grains induces an increase in the return on land used in feed grain production and hence a 4.5 percent increase in feed grain acreage.

Income and price elasticities of demand for the private domestic household were obtained by estimating a complete demand system for eight food groups and one nonfood aggregate (appendix B). Government demands are assumed to be determined legislatively, and are thus not price responsive in the model. Moreover, any change in the government expenditures is assumed to be allocated proportionately across all demands.

The final group of parameters required by the model are those which determine the responses of imports and exports to relative price changes. On the import side, this is tantamount to specifying an Armington elasticity of substitution between domestic and imported goods. When a product is relatively difficult to trade, as is the case with raw livestock products, this parameter is small (0.5 in the model). By contrast, a product such as prepared feeds is quite homogeneous and is given a large Armington elasticity (4.0). The Armington parameters for dairy and sugar products are specified in such a way that, in the long run, the model generates a plausible influx of imports when trade barriers are removed. Specifically, the model reproduces the same increase in imports (relative to domestic production) as is predicted by the U.S. Department of Agriculture's (USDA) multicommodity trade model (SWOPSIM) under unilateral trade liberalization (Roningen, Sullivan, and Wainio 1987).[2]

Export price elasticities of demand for the major export crops are taken from a USDA study (Seeley 1985, tables 5, 9, and 13). They represent two-year responses, although the implications of increasing these to their longer run (four-year) levels are also explored. The own price elasticities follow (four-year responses are given in parentheses): wheat −1.49 (−2.15), feed grains −1.70 (−2.65), and protein feed (used in the model for soy meal, soybeans, and other prepared feeds) −1.52 (−1.78). Seeley's cross-price elasticities are also included in the model. Due to their smaller market share, other agricultural products are assigned a larger elasticity of −2.0 (−3.0). Nonagricultural products are assumed to face an export demand elasticity of −2.0 (−3.0).

Policy Liberalization Experiments

In this section, results from the policy liberalization experiments are reported. Emphasis is placed on the impact of removing those distortions specific to agricultural markets. While these agricultural trade and policy wedges are completely eliminated, other distortions, including the general system of taxes, nonagricultural tariffs, and transportation subsidies, are not altered. Thus domestic "liberalization" is only partial. Furthermore, the demand, and supply functions, for farm and food products in the rest of the world are not altered. Thus the simulated liberalization is a unilateral one.

Treatment of Set-aside Acreage

Complete elimination of all agricultural subsidies removes the incentive for holding farmland out of production. Thus, in our experiments all set-aside acreage moves back into production. Of course, land which was lured into, for example, wheat production because of generous farm programs may return to grazing or other crop production when these program incentives are eliminated. The extent to which this acreage shifting occurs will be a function of relative returns per acre in competing uses, as well as the elasticity of transformation among land types (appendix B, figure 9B.2).

Factor Mobility Assumptions

In tables 9.1, 9.2, and 9.3 two alternative sets of liberalization results are presented. The first set is called the "short-run" scenario. It has been constructed with a two-year time horizon in mind. The following factor mobility assumptions are made:

–(SRL): Farm labor (primarily proprietor and family labor) is mobile within agriculture, but immobile out of the farm sectors. Nonfarm labor is mobile among nonfarm sectors.

–(SRK): Capital is immobile out of agriculture; however, crop capital is free to move among crops sectors. Livestock capital is sector-specific and nonfarm capital is mobile among nonfarm sectors.

Thus, in the short run there is little potential for moving resources out of agriculture, but there is considerable leeway for shifting labor and capital among alternative farm activities.

In the "long-run" scenario (four years or more), perfect factor mobility is introduced so that (LR) is now the operable assumption:

–(LR): The market prices net of taxes and subsidies of labor and capital in the farm and nonfarm sectors are equal.

Associated with these two domestic factor mobility scenarios are two alternative sets of export demand elasticities (detailed above). They are taken from Seeley (1985), who simulated the rest of the world's response to a U.S. price shock using the IIASA model. These export demand elasticities reflect increasing price responsiveness over time, as factors are reallocated within the foreign economies. To be compatible with the domestic scenarios, Seeley's two-year and four-year export demand elasticities are used here.

Price Effects

The commodity and factor price effects of complete liberalization in agriculture are presented in table 9.1. Owing to the presence of price wedges in initial equilibrium, the percentage change in one firm's price may not equal the price change faced by other firms or by the households. In this table percentage changes in the producing firm's price and in the private household's price are reported. Consider first the short-run results. Higher market prices for program crops indicate that the release of set-aside acreage, and subsequent outward shift in supply, is insufficient to offset the effects of lower input and output subsidies. Raw dairy and sugar prices drop, as the influx of processed imports augments domestic availability of these commodities. The price of other crops also falls. This is due to the availability of excess labor and crop capital released from the program crops sectors.

The decline in demand for farm labor and capital is reflected in lower short-run factor returns. The largest percentage declines are in the rents paid to owners of crop, dairy, and poultry capital. In the short run, payments to owners of existing dairy capital are completely eliminated. Land rents drop by less than labor and capital returns in the short run.

In the long run labor and capital leave agriculture in favor of the higher returns offered by nonfarm employment. Thus, most of the costs of reduced farm subsidies are passed forward to consumers in the form of higher food prices while land rents drop by an additional 3.22 percent. The only agricultural prices which drop are the prices of sugar and other crops. It is striking that the price paid by domestic consumers for processed dairy products increases under the "long run" scenario. This arises because the absolute increase in dairy imports is not large enough to outweigh the effects of (1) higher feed prices, (2) a higher cost of capital, and (3) demand-stimulating cross-price effects in consumption.

The price of imports, relative to the numeraire (nonfarm labor), rises under both the short- and long-run scenarios. This is necessary in order to achieve balance of payments equilibrium in the face of an exogenous capital account. As farm export prices rise, elastic foreign demand reduces expenditures on U.S. exports. Thus, ceteris paribus, import expenditures must also shrink. However, the demand for imports is stimulated by lower domestic prices for foreign sugar, dairy, and red meat products. Import prices must rise in order to equilibrate these forces.

The quantity changes engendered by this unilateral liberalization in U.S.

Table 9.1 Change in Selected Prices (percent)

	Short run		Long run	
	Firm price[a]	Private household price	Firm price[a]	Private household price
Commodity markets				
Raw commodities				
Dairy	−5.79	−5.79	4.23	4.23
Poultry	−0.84	−0.84	3.66	3.66
Red meats	−0.87	−0.87	3.70	3.70
Cotton	−11.60	5.60	−5.13	12.07
Food grains	−11.15	17.35	−9.31	19.20
Feed grains	−5.44	7.54	−3.56	9.42
Sugar crops	−24.31	−24.31	−19.71	−19.71
Oil seeds	−1.55	1.24	0.37	3.16
Other crops	−6.39	−6.39	−0.33	−0.33
Processed commodities				
Red meats	−1.23	−1.23	1.83	1.83
Poultry	−0.62	−0.62	2.36	2.36
Dairy	−3.13	−3.13	0.59	0.59
Sugar	−14.01	−14.01	−13.50	−13.50
Factor markets				
Labor				
Farm	−16.61	−16.61	0	0
Nonfarm (numeraire)	0	0	0	0
Capital services				
Crops	(see appendix C)	−28.89	(see appendix C)	−2.10
Dairy	−83.80	−100.00	21.40	−2.10
Poultry	−0.64	−30.26	27.52	−2.10
Red meats	0.07	−17.61	15.58	−2.10
Nonfarm	−1.64	−1.64	−2.10	−2.10
Land	(see appendix C)	−14.98	(see appendix C)	−18.20
Fertilizer	−0.06	−0.06	−0.25	−0.25
Prepared feeds	1.42	1.42	2.15	2.15
Imported commodities	1.86[b]	1.86	1.48[c]	1.48

[a] For raw and processed commodities this is the price received by the firm producing this commodity. For factors of production this is the price paid by the firm employing this factor.
[b] The firm prices of imported red meats, dairy, and sugar drop by 10.35, 19.35, and 26.65 percent, respectively.
[c] The firm prices of imported red meats, dairy, and sugar drop by 10.73, 19.72, and 27.03 percent, respectively.

Table 9.2 Changes in Long-run Commodity Supply and Demand (billions of 1987 dollars)

Commodity	% Change dom prod	Dom prod	Interm use	Dom hhlds	Export	Imports
Raw food commodities						
Dairy	(−21.38)	−4.6	−4.6	*	*	*
Poultry	(−0.84)	−0.1	−0.1	*	*	*
Red meats	(−2.34)	−1.1	−1.1	*	*	*
Cotton	(−10.39)	−0.7	*	*	−0.7	*
Food grains	(−12.17)	−1.1	−0.1	*	−1.0	*
Feed grains	(−10.57)	−4.5	−4.1	*	−0.4	*
Sugar crops	(−70.63)	−1.3	−1.3	*	*	*
Oil seeds	(1.04)	0.2	*	*	0.2	*
Other crops	(−0.02)	*	−0.2	0.1	0.1	*
Processed agr, and food commodities						
Red meats	(−1.71)	−0.9	*	−0.2	*	0.7
Poultry	(**)	*	*	*	*	*
Dairy	(−24.98)	−8.6	*	*	*	8.7
Other food	(0.69)	0.3	*	0.1	0.1	−0.1
Wet corn milling	(−1.23)	*	*	*	*	*
Feed and flour milling	(0.11)	0.1	*	*	*	*
Prepared feeds						
Dairy	(−13.82)	−0.6	−0.6	*	*	*
Poultry	(2.11)	0.1	0.1	*	*	*
Red meats	(3.76)	0.3	0.3	*	*	*
Sugar	(−79.45)	−3.8	0.1	0.1	*	3.9
Fats and oils	(0.77)	0.1	*	*	0.2	*
Other agr. commod.	(1.06)	0.5	*	0.1	0.1	−0.4
Other commodities[a]						
Agr inputs	(−0.69)	−1.2	−1.7	0.1	0.1	−0.3
Other services	(0.24)	6.5	0.4	2.7	3.4	*
Other manufacture	(0.87)	13.1	−1.8	0.8	7.5	−6.6

Notes: Equilibrium requires that the sum of changes in intermediate use, domestic households' demand, and exports must be equal to the sum of changes in domestic production and imports. However, column sums in this table are not equal because figures have been rounded.

The model is actually solved for percentage changes in quantities measured in 1977 dollars (see appendix B). For ease of comparison, these have been converted to 1987 dollars by applying the common conversion factor: $1 in 1977 = $1.75037 in 1987.

[a] These rows represent the aggregation of results for 18 nonfood sectors into three broad groups for reporting purposes.

*This entry is less than 0.05 $billion in absolute value.

**This entry is less than 0.005 percent in absolute value.

agriculture are presented in table 9.2. These refer to the long-run outcome when labor and capital are mobile out of agriculture. All entries are in billions of 1987 dollars. It should be emphasized that these are not changes in receipts, since they do not include the effect of price changes. They are pure quantity effects, where one unit is defined as the amount of a commodity which can be purchased for one dollar, at market prices in initial equilibrium.

The largest long-run percentage adjustments in domestic production occur in the raw and processed sugar sectors (−70.63 percent and −79.45 percent). The largest absolute long-run drops in output are in the raw and processed dairy sectors ($4.6 and $8.6 billion, respectively). The feed grains sector also experiences a large drop in long-run output ($4.5 billion). The majority of this drop is caused by declining feed demand in the domestic economy. (Intermediate uses of feed grains drop by $4.1 billion.) The only farm sector to increase output in the long run is oil seeds. This is due to the cross-price effect between feed grains and soy meal in the domestic and foreign feed mixes.

This contraction of agriculture translates into an exodus of labor and capital from the farm sectors. We estimate that, in the long run, an additional 5.5 percent reduction in the U.S. agricultural labor force would occur as a result of unilateral agricultural policy liberalization. (This is over and above the ongoing exodus of labor from agriculture due to technical and structural change.) The long-run stock of nonland farm capital is projected to fall by 13.9 percent.

The final group of results in table 9.2 refers to the impact of agricultural trade and policy liberalization on the nonfood sectors. Farm input suppliers are hurt, but the other services and manufacturing sectors experience a combined $19.6 billion increase in output. This is driven by three general equilibrium forces. The first of these stems from the factor market linkages identified in figure 9.1. As labor and capital leave agriculture, they may now be employed by other industries. This lowers nonfood production costs, hence increasing nonfarm output and exports in the new equilibrium.

The second phenomenon stimulating the nonfood sectors is that they become more competitive, relative to foreign producers. This is because, as noted above, the relative price of imports must rise in order to maintain balance of payments equilibrium in the face of an exogenous capital account. As a result manufactured imports fall, and these are replaced by domestic production.

Finally, as will be shown below, eliminating a large group of distortions reduces excess burden in the economy and real domestic income goes up by almost $5 billion. This increased income is allocated among consumption items according to the income elasticities of demand given in table 9B.4 of appendix B. As a result, the household demand for services increases by $2.7 billion.

Table 9.3 presents the short- and long-run welfare effects of agricultural policy liberalization in the U.S. Equivalent variations for the domestic and foreign households are decomposed into their component parts. For example, domestic households could pay $3,105 million in exchange for lower short-run food prices, and still be just as well off as before liberalization. However, they would require $2,402 million to compensate them for the higher food prices they would face in the long run. Foreign households, in their role as consumers of U.S. food exports, suffer under both scenarios. They also lose $1,115 million in reduced dairy and sugar quota rents. However, they sell a lot more of these products to U.S. consumers. This induces a terms of trade effect which benefits the rest of the world, at the expense of U.S. consumers who must now pay more for all imports.

In the short run most of the domestic burden falls on the relatively immobile farm factors of production. From the point of view of the aggregate domestic household, this is offset by the increased treasury revenues which are transferred back in a lump sum equal to $12,884 million. In the long run, as labor and capital move into higher tax, higher productivity, nonfarm uses, this change in net revenue increases slightly to $13,838 million. Thus, the United States as a whole is unambiguously better off as a result of liberalization. This means that farmers could be fully compensated for their losses and some money would still be left over.

The issue of compensation is important and deserves further discussion. In the long run, the main losers in the farm sector are the landowners. At a real interest rate of 5 percent, the capitalized value of their losses equals $113.8 billion. This would be devastating for a sector which is already experiencing severe financial problems due to high debt/asset ratios. Some form of severance payments to these landowners will be required in order to make such a policy palatable. However, the funds will be available, since the capitalized value of treasury savings (at a 5 percent real discount rate) is $276.8 billion.

In the shorter run adjustment assistance for labor and some compensation to owners of nonland capital will be required. Table 9.3 estimates that the proper amount for such annual payments will be about $4.8 billion for farm

Table 9.3 Distribution of Gains and Losses from Unilateral Liberalization of U.S. Agricultural and Food Policies: Equivalent Variations (millions of 1987 dollars)

	Short run		Long run	
	Domestic households	Foreign households	Domestic households	Foreign households
Food	3,105	−1,280	−2,402	−2,051
Nonfood	6,634	117	9,347	418
Imports	−186	5,447	−149	4,351
Nonfarm labor (numeraire)	0	0	0	0
Nonfarm capital services	−7,595	674	−9,821	861
Subtotal	1,958	5,018	−3,025	3,579
Farm labor	−4,776	0	0	0
Crop capital services	−1,019	0	−74	0
Livestock capital services	−2,347	0	−121	0
Land services	−4,682	0	−5,690	0
Subtotal	−12,824	0	−5,885	0
Transfer	12,884	−1,155[a]	13,838	−1,155[a]
Total	2,018	3,863	4,928	2,424

Note: The model is actually solved for percentage changes in quantities measured in 1977 dollars (see appendix B). For ease of comparison, these have been converted to 1987 dollars by applying the common conversion factor: $1 in 1977 = $1.75037 in 1987.

[a] This represents the loss in rents associated with elimination of the sugar and dairy quota (based on 1977 import levels, but the 1984 domestic/world price differential).

labor and \$3.4 billion for owners of capital. These payments should be transitory, only covering the period required to redeploy these resources in the nonfarm economy.

Conclusions

One rather concise way of summarizing the economywide effects of liberalizing U.S. agricultural policies is to compare them to the number of farm jobs which would be lost. Such ratios may also be interpreted as the average annual cost of protecting one farm job with the current configuration of policies. This study has found these costs to include (1) reduced nonfood output (−\$107,000 per farm job saved), (2) increased treasury outlays (\$80,500 per farm job saved), and (3) lower real domestic income (−\$28,700 per farm job saved).

In addition to lowering agricultural employment, unilateral policy liberalization induces capital to leave agriculture and lowers land values. However,

Appendix A. Detailed Listing of Sectors in the Model

CGE model sectors and associated input-output identifiers

Sector name	1977 I/O Sector Numbers
Dairy farm products	1.01
Poultry and eggs	1.02
Meat animals	1.0301
Cotton	2.01
Food grains	2.0201
Feed grains	2.0202
Sugar crops	2.0502
Oil-bearing crops	2.06
Other farm products	1.0302, 2.0203, 2.03, 2.04, 2.0501, 2.0503
Meat products	14.0101, 14.0102
Poultry products	14.0103, 14.0104
Dairy products	14.02–14.06
Canning, freezing, and dehydrating	14.07–14.13, 14.30, 14.32
Wet corn milling	14.17
Feed and flour milling, confectioner, bakery, and macaroni	14.31
Prepared feed nec	14.1502 Disaggregated into three sectors
Sugar	14.19
Nonalcoholic beverages and flavorings	14.22–14.23, 14.2002, 14.2003, 14.28
Alcoholic beverages	14.21
Fats and oils	14.24–14.27, 14.29
Forestry, fishery, and horticultural products	2.07, 3.0, 4.0002
Agricultural services	4.0001
Other mining	6.0–7.0, 9.0
Crude petroleum and natural gas	8.0
Chemical and fertilizer mining	10.0
Tobacco and fiber manufacturers	15.0–19.0
Fertilizer	27.02
Chemicals (no fertilizer)	27.01, 27.03–27.04
Petroleum ref. and related products	31.01
Rubber and miscellaneous plastics	32.0
Leather and leather products	33–34
Other manufacturing	13, 20–26, 28–30, 31.02, 31.03, 35–64
Transp., wareh., wholesale/retail	65.0, 69.0
Electricity services	68.01
Gas production and distribution	68.02
Steam, sanitation, and irrigation	68.0302
Finance, insurance, and business services	70.0, 73.0
Real estate	71.0
Other noncommodities	11–12, 66, 67, 68.0301, 72, 75–79
Eating and drinking places	74.0 Incorporated into final demand
Special industries	82–85 Incorporated into final demand

our results indicate that the owners of these farm assets can be more than compensated for their losses by using a portion of the budget savings generated by this experiment. Furthermore, it should be pointed out that the losses to agriculture as a whole would be much less if other countries were simultaneously to liberalize their farm policies. Roningen, Sullivan, and Wainio estimate that farm sector losses from unilateral policy liberalization are cut in half when liberalization is global. This is because export prices facing U.S. producers increase significantly as excess resources are withdrawn from agricultural production worldwide.

In sum, there are substantial economywide benefits to be realized through removal of current domestic and trade policy interventions in U.S. agriculture. Nonfood producers, taxpayers, and consumers all stand to gain from such measures. Furthermore, these gains are sufficient to compensate farmers for their losses, even if other nations do not simultaneously liberalize their agricultural policies.

Appendix B. Supplementary Discussion of the Model

General Structure

The general structure of this CGE model follows Keller (1980). His model is in the Johansen (1974) tradition, whereby the structure of the economy is approximated in the neighborhood of a particular point of interest, with a set of log-linear equations. This concept of a local approximation is compatible with recent work on consumer and producer behavior (e.g., Fuss and McFadden 1978). Most of this research is conducted with flexible functional forms designed to provide a local, second-order approximation to the true, but unknown production/utility structure (Diewert 1973). Since these unrestricted elasticities are only valid in the neighborhood of the point of approximation, the results from this CGE model, which employs estimates from several flexible demand systems, will be only locally valid as well.

Two types of information are required by the Keller model. Information concerning net expenditures by all agents in the initial equilibrium situation generates the (locally constant) expenditure shares in the behavioral equations for firms and households. The second type of information describes marginal responses to changes in prices, output, and income. Based on initial prices (which will differ among firms and households in the presence of taxes), equilibrium quantities may be extracted from the equilibrium expenditures. These quantities generate the share weights which are used to aggregate the behavioral responses (elasticities) of firms and households to the market level where the general equilibrium solution is obtained.

Expenditures in Initial Equilibrium

The economywide set of accounts developed for this study is constructed in two parts. First, a consistent set of dollar flows is established for the entire U.S. economy. This is based on the most recent input-output table (1977) available (U.S. Department of Commerce 1984). Additional discussion of the data base modifications and manipulations is available in Hertel and Tsigas (1988). The next step involves inserting a set of 1984 policy wedges into these accounts. (See Hertel, Chattin, and Tsigas 1987, for a more detailed treatment of this topic.) These wedges are crucial in determining the excess burden as well as the fiscal implications of any new policy intervention.

Table 9B.1 identifies the types of distortions incorporated into the initial equilibrium. They reflect 1984 policies and are modeled as ad valorem price wedges. These interventions are grouped into two categories, those applying to outputs and intermediate inputs and those applying to primary factors of production. A positive sign indicates that the effect of the wedge is to raise the firm (or household) price above the equilibrium market price. In the case of outputs this is a subsidy, while it would represent a tax for an intermediate input, a primary input, or a commodity purchased by one of the households. A negative sign indicates that the wedge has the opposite effect.

There are two distinct types of interventions in this table, namely those that are altered in the liberalization experiment and those that are left unchanged. (The unaltered wedges are placed in parentheses.) Some discussion of the treatment of these wedges is in order. Those government payments tied explicitly to output are treated as output subsidies. A variety of farm programs serve to lower the per unit cost to farmers of using capital and land. Dairy and sugar programs raise the prices received by domestic producers and those paid by U.S. consumers, relative to world price levels. The final farm program effect treated here is that of acreage reduction. In contrast to all of the previous wedges, this limitation in land used for program commodities tends to reduce output.

There are three important characteristics of the acreage set-aside programs in U.S. agriculture: (1) the land is left idle (or occasionally permitted to move into very low-value crops such as hay); (2) the shadow price of land in the production of program crops is higher than would otherwise be the case; and (3) most of the incentive for setting aside acreage comes in the form of output subsidy "bribes"—namely deficiency payments on program crop production. In order to capture these three factors in the benchmark equilibrium, we proceed as follows. The government rents the idled acreage and the cost of this rental activity is fully subsidized by the treasury. Thus its social marginal value product is zero in initial equilibrium. This captures point (1). At the same time there is a tax on the use of program cropland in production. This accomplishes (2), and (3) as well, since the tax is computed to exactly offset the subsidy on the government's land rental. Thus the set-aside program is fiscally neutral. This circumvents double counting farm program expenditures, since the deficiency payment "bribes" are already incorporated as output subsidies in the initial equilibrium accounts.

Economywide price wedges are unaltered in the subsequent analysis. However they are still important, particularly to the extent that they affect agriculture differentially. Transport subsidies capture the annual cost of inland waterways not covered by users. These subsidies tend to lower the cost of mining and agricultural outputs, relative to other products. Differential treatment of farm and food sectors in the basic tax structure has also been shown to have an important impact on the size and mix of U.S. agriculture (Hertel and Tsigas 1988). Average tax rates for 1984 are based on the work of Boyd (1988). Taxes are levied on the use of labor and capital, as well as output, retail sales, and income. These rates are approximated with ad valorem price wedges.

A condensed version of this benchmark data set is reported in table 9B.2, which provides net expenditures by industries and households on goods and services. The first row of table 9B.2 describes the sale and purchase of the aggregated, net output of the forty-one producing sectors in 1977 dollars. This totals \$1.88 trillion. Final demands for these products are as follows: investment, \$373 billion; private consumption, \$1.28 trillion; government purchases, \$187 billion; and exports, \$140 billion. The presence of output and consumption taxes means that consumers of a given product pay more than producers receive. This gives rise to a positive row total equal to the resulting tax revenue. (This total would be larger in the absence of agricultural output subsidies.)

In order to handle savings and investment in a static model, we follow Johansen (1974) and Keller (1980) by introducing a "dummy" capital goods sector which collects and distributes investment goods. Replacement invest-

Table 9B.1 1984 Price Wedges Employed in Equilibrium Data Set

	Productive sectors						
	Dairy	Poultry	Red meats	Cotton	Food grains	Feed grains	Sugar
Commodity wedges							
Output wedges							
Def. payments[a]				+	+	+	
Disaster payments[a]							
Crop insurance[a]				+	+	+	+
Govt. storage and invent[a]				+	+	+	
Interest rate[a]				+	+	+	
Output tax[b]	(−)	(−)	(−)	(−)	(−)	(−)	(−)
Net output wedge	(−)	(−)	(−)	+	+	+	−
Proc. dairy program[a]	+	+	+	+	+	+	+
Proc. sugar program[a]	+	+	+	+	+	+	+
Import tariff[c]							
Transport subsidy[f]	(−)	(−)	(−)	(−)	(−)	(−)	(−)
Sales tax							
Primary factor wedges							
Capital services							
FmHA/FCS[d]	−	−	−	−	−	−	−
Factor tax[b]	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Net capital services wedge	+	−	+	+	+	−	−
Land services							
FmHA/FCS[d]	−	−	−	−	−	−	−
Land and structural improvement	−	−	−	−	−	−	−
Grazing[a]			−				
Acreage reduction[e]							
Factor tax	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Net land wedge	+	+	+	+	+	+	+
Labor services							
Factor tax[b]	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Income tax[e]							

Note: Positive sign indicates presence of wedge raises firm receipts (payments) or household payments (receipts). Negative sign implies the opposite. Unaltered wedges are placed in parentheses.

Sources:

[a] Chattin 1987 (and unpublished worksheets). See also U.S. Dept. of Agriculture 1987.

[b] Boyd 1988.

Productive sectors								Households		
Oil seeds	Other crops	Proc. dairy	Proc. sugar	Proc. red meats	Trans. warh. w/r	Other firms	Land distr.	Private	Govern-ment	Foreign
+										
+										
+										
(−)	(−)	(−)	(−)		(−)	(−)				
+	−	(−)	(−)		(−)	(−)				
+	+	+	+		+	+		+	+	−
+	+	+	+		+	+		+	+	−
				+		(+)				
(−)	(−)	(−)	(−)		(−)	(−)				
								(+)		
−	−									
(+)	(+)	(+)	(+)	(+)		(+)	(+)			
−	−	−	(+)		(+)	(+)				
−	−									
−	−									
							(−)		−	
(+)	(+)									
+	+									
(+)	(+)	(+)	(+)		(+)	(+)				
								(−)		

[b] Boyd 1988.

[c] Cline et al. 1978 (table 2-1), and UNCTAD (1982), paragraph 32.

[d] Hughes et al. 1987.

[e] Hertel, Chattin, and Tsigas 1988.

[f] U.S. Army Corps of Engineers 1984 (table 5).

Table 9B.2 Net Expenditures at Net Prices (millions of 1977 dollars; receipts are indicated by negative expenditures)

	41 Industries	Capital goods	Private domestic household	Government domestic household	Foreign household	Row total (taxes)
41 Industries	−1,886,013	373,573	1,281,990	187,675	140,446	97,671
Capital goods	218,101	−349,275	205,990	846	1,560	77,222
Imports	170,970	53	1,551	4,135	−167,235	9,474
Labor services						
Farm	20,957	0	−16,426	0	0	4,531
Nonfarm	1,015,690	0	−953,287	203,675	−29	266,049
Capital services						
Crops	1,977	0	−2,014	0	0	−37
Dairy	812	0	−774	0	0	38
Poultry	552	0	−559	0	0	−7
Red meats	2,170	0	−1,940	0	0	230
Nonfarm	432,538	−24,351	−266,450	−765	23,411	164,383
Land services	22,246	0	−17,852	1	0	4,395
Column total (Transfers)	0	0	230,229	395,567	−1,847	623,949

ment is assumed to equal purchases of scrap and depreciation, and is entered in the capital goods row for the thirty-eight nonlivestock sectors. (Livestock sectors are assumed to generate their replacement investment internally.) The remaining portion of capital goods output (net investment) is allocated to the domestic household as savings.

Imports of foreign goods are treated as augmenting the domestic availability of output from the forty-one producing sectors. When combined with direct sales to final demand, total imports ($167 billion) are obtained. These are supplied by the foreign household.

The remaining rows of table 9B.2 document the flows of primary factor service payments to the private domestic household. Note that labor is disaggregated into farm and nonfarm components. Similarly, capital stocks generating capital service flows to the private households are disaggregated into crop capital (e.g., tractors and combines), three types of livestock capital, and all other (nonfarm) capital. Finally, the payments to land are accounted for. Each of these factor service flows generates net tax revenue. In the case of crop and poultry capital, the estimated value of credit subsidies exceeds estimated tax revenue and the row totals are negative. A total of $624 billion in taxes (net of subsidies) is collected by the treasury (sum of row totals) which must equal the sum of transfers to households.

Marginal Behavior of Firms and Households

Keller and most other CGE modelers (e.g., Ballard et al. [1985]; and Dervis, de Melo, and Robinson [1982]; Jorgenson [1984] is an exception) employ nested CES relationships to describe production and utility structures in their CGE models. This study departs from a strict adherence to convenient functional forms to incorporate more flexible demand systems in the model. Thus specification of the domestic household's demand for food builds on the recent work of Huang and Haidacher (1983). The derived demand for inputs by crop and livestock farms is based on an aggregate translog cost function for U.S. agriculture.

In the absence of commodity-specific time series data on input use, an aggregate multiproduct cost function was estimated based on the data of Ball (1985; Hertel, Ball, Huang, and Tsigas 1987). Inputs and outputs were defined to match sectoral disaggregation and factor concepts in the CGE model. Assuming a translog cost function, a system of cost and revenue share equations was derived for seven inputs (crop capital [durable equipment], land, livestock capital [herd and structures], labor, feed, fertilizer, and other inputs) and nine outputs (dairy, red meats, poultry, feed grains, food grains, oil seed crops, sugar, cotton, and other crops). Constant returns to scale were imposed and a time trend was included in each share equation to represent technical change over the sample period (1948–79). The estimated partial elasticities of substitution, evaluated at the fitted 1977 shares, are reported in table 9B.3.

Since factor tax (and subsidy) rates differ across agricultural commodities, the production of each commodity must be treated as an independent activity facing a distinct vector of factor prices. In order to utilize the estimated matrix of substitution effects, while permitting each sector to face different factor prices, the same seven by seven matrix of Allen partials was assigned to each individual farm sector. The sectoral demand elasticities will differ across commodities since they are equal to the Allen partials weighted by the cost share which corresponds to the relevant input price. For example, the demand elasticity for feed in the crops sectors will be zero owing to a zero cost share for feed in those activities. However, the shape of the aggregate farm sector isoquants will reflect the substitutability implied by the multiproduct cost function.

Figure 9B.1 provides the overall structure of domestic production in the agricultural sectors. Total supply is modeled as a CES aggregation of foreign

Table 9B.3 Estimated Allen Partial Elasticities of Substitution for U.S. Agriculture (evaluated at fitted 1977 shares; approximate t-values in parentheses)

	Land	Crop capital	Livestock capital	Labor	Feed	Fertilizer	Other[a] inputs
Land	−3.31	0.01	−0.12	−0.33	0.52	0.68	0.79
	(−1.8)	(0.2)	(−0.4)	(−1.0)	(3.2)	(2.8)	
Crop capital		−2.77	0.48	−1.20	0.92	0.67	1.49
		(−5.2)	(2.0)	(−3.7)	(4.3)	(1.9)	
Livestock capital			−3.11	0.27	0.58	0.28	1.04
			(−13.9)	(1.3)	(4.2)	(1.2)	
Labor				−0.84	0.07	−0.83	1.99
				(−2.1)	(0.3)	(−2.1)	
Feed	(Symmetric)				−0.91	0.50	−0.37
					(−4.5)	(1.4)	
Fertilizer						−6.91	2.07
						(−6.2)	
Other inputs							−4.88
Fitted cost shares	0.07	0.12	0.14	0.20	0.23	0.07	0.17
	(7.8)	(35.4)	(37.8)	(34.1)	(65.8)	(46.0)	
Time trend in share equation	−0.0002	0.0018	0.0024	−0.0077	0.0003	0.0020	−0.0014
	(−0.4)	(4.5)	(7.1)	(−11.2)	(1.2)	(8.3)	

Note: For details on variable definition, aggregation, and specific treatment in the model, see Hertel et al. (1987). The eigenvalues of the hessian of the cost function with respect to these 7 input prices follow: 0.99, −22.67, −8.40, −6.83, −0.00, −3.87, −1.84.

[a] Coefficients associated with other inputs are derived via homogeneity. Approximate standard errors are not computed for these elasticites.

and domestic production which, following Armington (1969), are treated as imperfect substitutes. The ease with which this substitution occurs, as measured by σ^m, varies by commodity and is a function of product homogeneity. Figure 9B.1 also shows the feed input as a nested CES aggregate of the on farm feed mix and purchases from the prepared feeds sectors. The on farm mix is a combination of feed grains and soy meal. Substitution between these inputs varies across livestock types and is identical to the grain-protein substitution parameter used for prepared feeds.

Figure 9B.2 shows how a nested constant elasticity of transformation (CET) function "transforms" one type of land into another. The land groups include sugar, cotton, food grain, feed grain, oil seeds, and other agricultural land. Other agricultural land is employed in the production of both other crops and

Figure 9B.1 Production Structure in the Farm Sectors

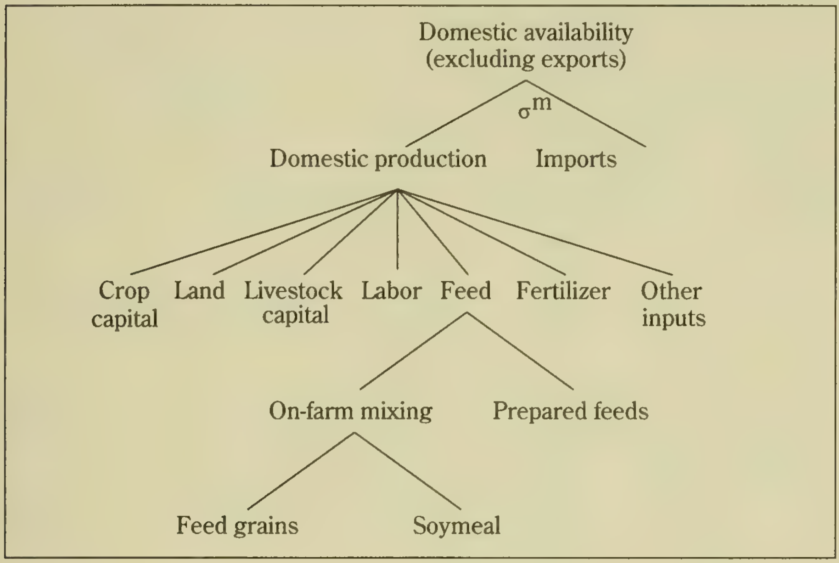


Figure 9B.2 The Land-distributing Sector

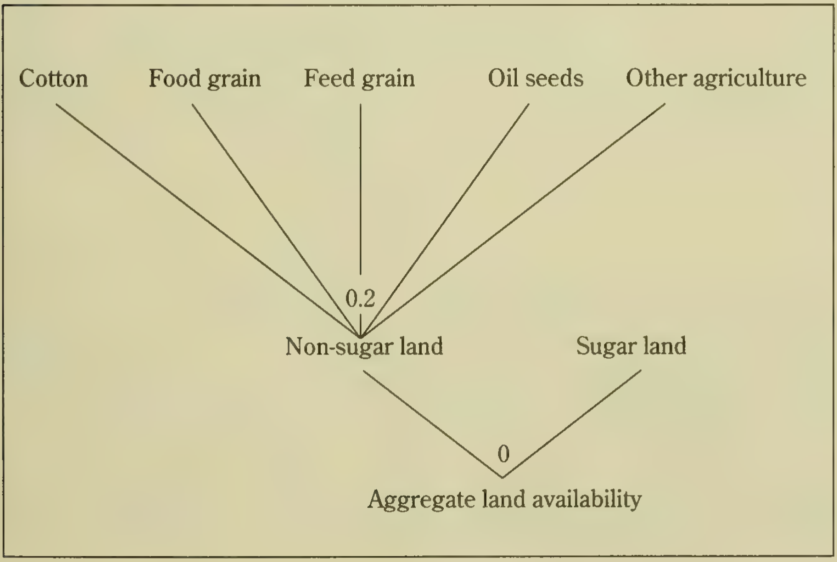
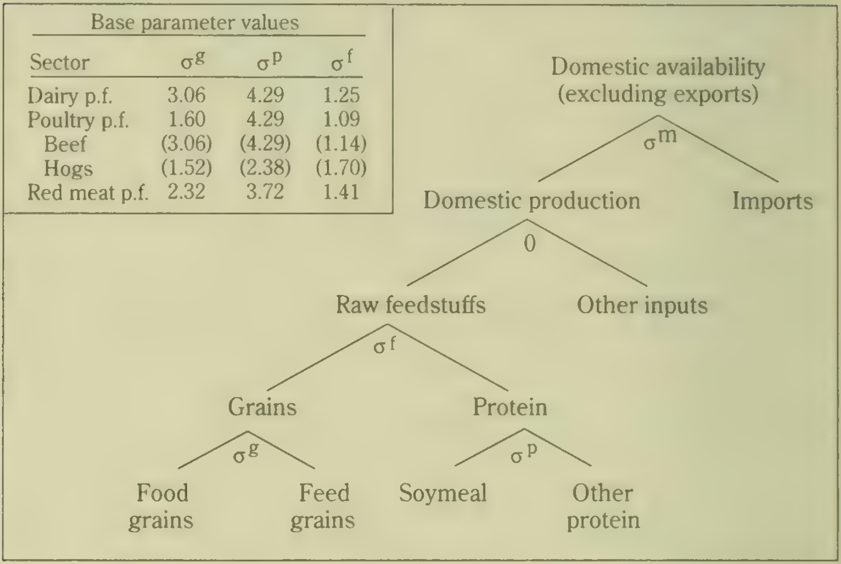


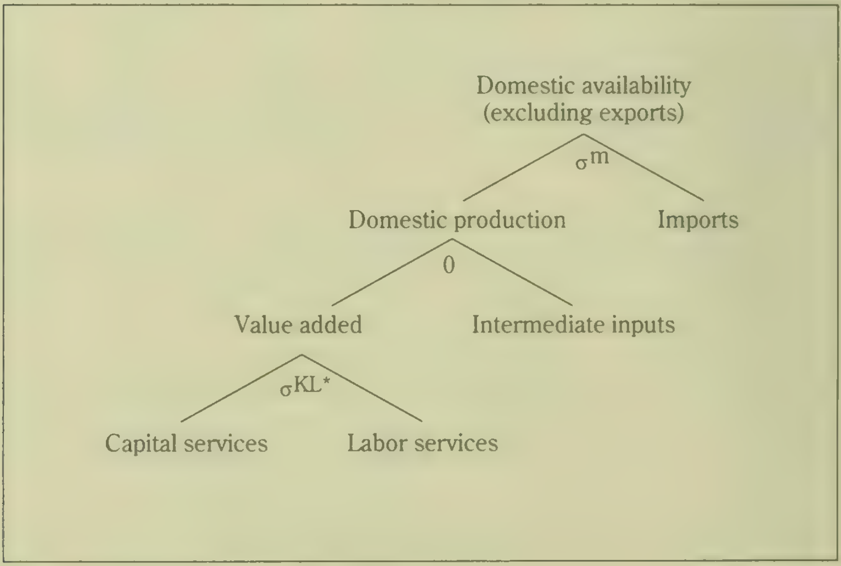
Figure 9B.3 Production Structure in the Prepared Feeds Sectors



Base parameter values

Sector	σ^g	σ^p	σ^f
Dairy p.f.	3.06	4.29	1.25
Poultry p.f.	1.60	4.29	1.09
Beef	(3.06)	(4.29)	(1.14)
Hogs	(1.52)	(2.38)	(1.70)
Red meat p.f.	2.32	3.72	1.41

Figure 9B.4 Production Structure in the Nonfarm Sectors



* σ^{KL} taken from Ballard et al. 1985, 132–34.

livestock. A 0.2 constant elasticity of transformation among different types of nonsugar land gives the model generally plausible partial equilibrium (commodity price) acreage response elasticities.

Production technology in the prepared feeds sectors is summarized in figure 9B.3. Domestic output consists of a nested CES technology with separability between protein sources and grains. (This follows closely the work of John Zeitsch for the OECD.) The protein aggregate combines soy meal with other protein sources, while food grains may substitute for feed grains in the grain aggregate. These two elasticities of substitution, as well as the substitutability of grains for proteins, depend on the type of feed being produced. For example, the dairy and beef industries are assumed to substitute more easily between grains than can poultry producers.

Figure 9B.4 describes the production structure in the nonfarm sectors. Capital and labor are combined with a constant elasticity of substitution to produce a value-added aggregate. These substitution parameters are taken from Ballard et al. (1985, 132–34). Value added is then combined with intermediate inputs using the assumption of fixed coefficients.

Substitution in private household consumption is characterized by a nine by nine matrix of unrestricted demand elasticities which disaggregates food into eight groups and treats all nonfood consumption as a single aggregate. These elasticities (provided in table 9B.4) were obtained by reestimating the model reported in Huang and Haidacher (1983) using a slightly more aggregate data set and imposing symmetry, homogeneity, and Engel aggregation at the budget shares used in the CGE model. (See Hertel et al. 1987, for more details.) These commodity demands are the only source of price responsiveness for the domestic household since the demands for leisure and savings are fixed in this model.

Detailed Specification of the Experiment

As noted above, all price wedges are introduced in ad valorem fashion. For firms in the model, $p^F = t * p^M$, where p^F is the price received by the firm, p^M is the market price, and t is the ad valorem tax (subsidy) rate. When output supply is undistorted, $t = 1$. In the case of program crops (in 1984), $t > 1$ indicating that farmers receive a price in excess of the market price. Total differentiation yields: $\hat{p}^F = \hat{p}^M + \hat{t}$, where the hat (ˆ) denotes a percentage change from initial equilibrium. In the policy liberalization experi-

Table 9B.4 Estimated Demand Elasticities for the Private Domestic Household (second row provides the associated standard errors)

	Prices[a]			
Quantity	Red meat	Cereal	Poultry	Dairy
Red meat	−0.4587	0.0107	0.0328	−0.0338
	0.0271	0.0110	0.0107	0.0128
Cereal	0.0735	−0.0414	−0.0014	0.0621
	0.0451	0.0570	0.0296	0.0553
Poultry	0.1149	−0.0034	−0.1965	0.1273
	0.0313	0.0212	0.0234	0.0264
Dairy	−0.0252	0.0220	0.0683	−0.1501
	0.0191	0.0205	0.0137	0.0484
Fats	0.0227	0.0171	0.0820	−0.2535
	0.0423	0.0347	0.0245	0.0622
Sugar	−0.0374	−0.0034	−0.0215	0.0213
	0.0126	0.0070	0.0056	0.0079
Beverages	−0.0458	−0.0179	−0.0011	−0.0051
	0.0325	0.0127	0.0133	0.0171
O. food	0.0035	−0.0695	0.0657	0.0340
	0.0273	0.0303	0.0199	0.0667
N. food	−0.0284	−0.0131	−0.0189	−0.0300
	0.0022	0.0009	0.0009	0.0014
Weight[c]	0.0440	0.0108	0.0152	0.0292

[a] This is the 9 × 9 matrix of uncompensated price elasticities employed in the model, courtesy of Kuo Huang. For details on variable definition and treatment in the model see Hertel et al. (1987).

[b] These are the income elasticities of demand.

ment, t is reduced so that $\hat{t}<0$ and the "wedge" between firm and market prices is reduced.

Note that the value of t in initial equilibrium is determined by the full set of "wedges" described in table 9.1. Thus t is not equal to one plus the per unit output subsidy. It also includes a (small) output tax. Similarly, in the case of capital services employed in agriculture, the estimated FmHA/FCS subsidy serves to offset the capital income tax rate, resulting in a value of t which is closer to one. This does not, however, alleviate the factor market distortion. Since nonfarm sectors face higher capital tax rates and do not receive the benefit of low cost FmHA/FCS loans, the subsidy serves to exacerbate further an existing distortion. That is, the marginal value of product of capital in agriculture (in initial equilibrium) is far below the average for nonfarm sectors.

Fats	Sugar	Beverages	O. food	N. food	Expend[b]
0.0006	−0.0550	−0.0152	−0.0014	−0.0255	0.5455
0.0083	0.0120	0.0093	0.0031	0.0693	0.0673
0.0158	0.0005	−0.0145	−0.0307	0.0664	−0.1304
0.0279	0.0285	0.0151	0.0140	0.1034	0.0948
0.0470	−0.0601	0.0030	0.0220	−0.1471	0.0930
0.0140	0.0159	0.0112	0.0066	0.0782	0.0752
−0.0743	0.0446	0.0033	0.0069	0.1438	−0.0392
0.0185	0.0113	0.0071	0.0114	0.0533	0.0431
−0.1519	0.1135	0.0032	−0.0016	0.0661	0.1024
0.0434	0.0239	0.0147	0.0189	0.1062	0.0966
0.0206	−0.2014	−0.0247	0.0076	0.0400	0.1988
0.0048	0.0146	0.0071	0.0018	0.0756	0.0815
−0.0004	−0.0977	−0.1863	−0.0015	−0.0404	0.3963
0.0101	0.0239	0.0251	0.0032	0.1452	0.1545
−0.0035	0.0706	−0.0011	−0.1894	−0.0871	0.1769
0.0328	0.0158	0.0081	0.0435	0.0668	0.0480
−0.0085	−0.0420	−0.0104	−0.0054	−1.0037	1.1607
0.0008	0.0014	0.0011	0.0003	0.0082	0.0079
0.0067	0.0460	0.0128	0.0050	0.8281	

[c] These are the expenditure shares at which the neoclassical restrictions are imposed, for estimation purposes. They are also the actual expenditure shares, at consumer prices, used in the CGE model.

In the case of processed sugar and dairy products, both domestic producers and consumers face an artificially enhanced price, i.e., p^F, p^H exceed the world price. However, $p^F \neq p^H$ owing to the presence of output and sales taxes. Policy/trade liberalization in these markets involves reducing the "wedge" between domestic and world prices. (The costs of dairy and sugar imports are simultaneously reduced.)

Appendix C. Changes in Sectoral Costs of Capital and Land Services (in percentage)

	Short run firm price	Long run firm price
Crop capital services		
Cotton	−21.63	5.15
Food grains	−9.93	16.85
Feed grains	0.82	27.61
Sugar crops	22.47	49.26
Oil seeds	22.97	49.76
Other crops	23.50	50.29
Land		
Dairy	−5.14	−14.18
Poultry	−5.40	−14.44
Red meats	−0.09	−9.13
Cotton	−45.19	−63.93
Food grains	−21.42	−24.18
Feed grains	−13.42	−15.03
Sugar crops	−92.45	−96.72
Oil seeds	0	−0.60
Other crops	−4.79	−13.83

Notes

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1. The one exception is land employed in sugar crop production. This is fixed, reflecting the relatively limited alternative uses for sugarcane land. (See appendix B for more details.)

2. Unilateral trade liberalization experiments with USDA's SWOPSIM model (1984 base) predicted the following changes in imports, expressed as a percentage of domestic production: sugar, +88 percent and dairy products, +25 percent.

References

Antle, J. M. 1984. The structure of U.S. agricultural technology, 1910–78. *American Journal of Agricultural Economics* 66:414–21.

Armington, P. S. 1969. A theory of demand for products distinguished by place of production. *IMF Staff Papers* 16:159–78.

Ball, V. E. 1985. Output, input, and productivity measurement in U.S. agriculture, 1948–79. *American Journal of Agricultural Economics* 67:475–86.

Ballard, C. L., D. Fullerton, J. B. Shoven, and J. Whalley. 1985. *A general equilib-*

rium model for tax policy evaluation. Chicago: Univ. of Chicago Press.

Binswanger, H. 1974. A cost function approach to the measurement of factor demand and elasticities of substitution. *American Journal of Agricultural Economics* 56: 377–86.

Boyd, R. 1988. *An economic model of direct and indirect effects of tax reform on agriculture.* U.S. Department of Agriculture, Economic Research Service, Technical Bulletin no. 1743. Washington, D.C.

Chattin, B. L. 1987. Measures of government intervention in U.S. wheat, corn, sugar, and dairy markets. Paper presented at the 1987 AAEA meetings, August, East Lansing, Michigan.

Cline, W. R., N. Kawanabe, T. O. M. Kronsjo, and T. Williams. 1978. *Trade negotiations in the Tokyo Round: A quantitative assessment.* Washington, D.C.: The Brookings Institution.

Council of Economic Advisers. 1984 and 1986. *Economic report of the president.* Washington, D.C.: U.S. Government Printing Office.

Dervis, K., J. de Melo, and S. Robinson. 1982. General equilibrium models for development policy. New York: Cambridge Univ. Press.

Diewert, W. E. 1973. Functional forms for profit and transformation functions. *Journal of Economic Theory* 6:284–316.

Fuss, M., and D. McFadden. 1978. *Production economics: A dual approach to theory and applications.* Amsterdam: North-Holland Publishing Co.

Hertel, T. W., E. Ball, K. S. Huang, and M. E. Tsigas 1987. Computing general equilibrium, farm level demand elasticities for agricultural commodities. Department of Agricultural Economics, Purdue University, West Lafayette, Indiana. Typescript.

Hertel, T. W., B. Chattin, and M. E. Tsigas. 1987. General equilibrium analysis of producer subsidies for agriculture. Purdue University, West Lafayette, Indiana. Typescript.

Hertel, T. W., and M. E. Tsigas. 1988. Tax policy and U.S. agriculture: A general equilibrium approach. *American Journal of Agricultural Economics* 70(2):289–302.

Huang, K. S., and R. C. Haidacher. 1983. Estimation of a composite food demand system for the United States. *Journal of Business and Economic Statistics* 1:285–91.

Hughes, D. W., C. R. Bednarz, N. K. Osborn, and D. B. Hall. 1987. *Social costs and benefits of subsidized credit for the farm sector.* Texas Tech. Univ., Thornton Agricultural Finance Institute RWP 87.1. Lubbock, Texas.

Johansen, L. 1974. *A multisectoral model of economic growth.* Amsterdam: North-Holland Publishing Co.

Jorgenson, D. W. 1984. Econometric methods for applied general equilibrium analysis. In *Applied general equilibrium analysis*, ed. H. Scarf and J. Shoven. New York: Cambridge Univ. Press.

Keller, W. J. 1980. *Tax incidence: A general equilibrium approach.* Amsterdam: North-Holland Publishing Co.

Roningen, V., J. Sullivan, and J. Wainio. 1987. The impact of the removal of support to agriculture in developed countries. Paper presented at the 1987 AAEA meetings, August, East Lansing, Michigan.

Seeley, R. 1985. *Price elasticities from the IIASA world agriculture model.* U.S. Department of Agriculture, Economic Research Service, Staff Report no. AGES850418. Washington, D.C.

United Nations Conference on Trade and Development. 1982. *Protectionism and structural adjustment in the world economy.* TD/B/888/Rev. 1.

U.S. Army Corps of Engineers. 1984. *Waterborne Commerce Statistics of the U.S.* Washington, D.C.: U.S. Government Printing Office.

U.S. Department of Agriculture, Economic Research Service. 1987. *Government intervention in agriculture: Measurement, evaluation, and implications for trade negotiations*. Foreign Agricultural Economic Report no. 229 (April). Washington, D.C.

U.S. Department of Commerce, Bureau of Economic Analysis, Interindustry Economics Division. 1984. The input-output structure of the U.S. economy, 1977. *Survey of Current Business* 64, no. 5 (May): 42–84.

10. The Taxation of Australian Agriculture through Assistance to Australian Manufacturing

Peter J. Higgs

Summary

According to a recent report published by the U.S. Department of Agriculture (Ballenger, Dunmore, and Lederer 1987), of the twelve major agricultural producing countries Australia provides the least assistance to its agricultural sector. What these statistics do not reveal, however, is that Australian agriculture must compete for domestic resources against Australian manufacturing industries, many of which receive considerable protection from imports.

In this chapter estimates are first presented of the effects of unilaterally removing assistance to Australian agriculture. These estimates are based on simulations made with the ORANI multisectoral model of the Australian economy. It is found that removing assistance to agriculture would cause agricultural output to decline on average by 2.5 percent after about two years relative to what it would have been with the assistance in place. The contraction in agriculture leads to a small decline in the size of the economy. On the other hand, the revenue saved by the government through removing its assistance to agriculture results in an improvement in the public sector borrowing requirement. The international competitiveness of the traded sector is boosted from the fall in domestic prices and costs. The resultant stimulus to nonagricultural exports partially offsets the decline in agricultural exports. Aggregate imports are projected to decline owing to both the small contraction in

the size of the economy and the improvement in competitiveness of the domestic import-competing sectors.

Estimates are also presented of the effects of the removal of protection from imports for Australia's manufacturing sector. The removal of this protection lowers the price to domestic purchasers, including agriculture, of imported goods. This causes a switch toward imports, which results in a decline in output in some of the heavily protected sectors. However, the removal of protection also lowers the consumer price index. As wages are assumed to be indexed to the consumer price index, the first-round reduction in consumer prices flows into wages and hence back into further price reductions. The end result is an improvement in the competitiveness of traded activities, which includes agriculture. Agricultural output is projected to increase on average by 3.4 percent after about two years relative to what it would have been with manufacturing protection in place. There is a small increase in aggregate employment and real GDP and, mainly as a result of the government's loss of tariff revenue, an increase in the public sector borrowing requirement. These results are of particular interest given that the Australian prime minister, Mr. Hawke, in his address to the contracting parties of the GATT in Geneva on 22 October 1987, talked of phasing out "all our quantitative restrictions, including tariff quotas, licensing and embargoes."

Finally, estimates are presented of unilaterally removing assistance to both agricultural and manufacturing industries. The key findings of this study are that this package would result in an increase in aggregate employment, an increase in real GDP, and allow the government to reduce the public sector borrowing requirement. Furthermore, the net effect is for an increase of about 1 percent in agricultural output after about two years. Thus, if assistance to manufacturing industries is taken into consideration, then Australia is actually taxing its agricultural sector.

Introduction

Agriculture has been for the most part exempt from the conditions contained in the General Agreement on Tariffs and Trade (GATT).[1] As a result, world agricultural trade has for decades been subject to a myriad of distortions initiated by numerous agricultural producer organizations and governments.[2] Currently, protection afforded to agricultural industries is a growing topic of interest worldwide. This mood of reevaluation is evident in the initiative of the Cairns group, in the Davos proposal, and in the United States' mid-1987 proposals.[3] Partially as a result of these initiatives, agricultural trade distortions are currently being given some attention at the Uruguay Round of multilateral trade negotiations. However, some commentators (e.g., Carmichael 1986) believe that reform of the international agricultural trading system is most likely to be achieved by a better understanding in each of the major agricultural producing countries of the deleterious effects at home of their own domestic trade distortions. In this study estimates are presented of the effects of unilaterally removing assistance to Australia's agricultural and manufacturing industries.

In the case of Australia, the effects of subsidies and protection given to her agricultural and manufacturing industries is a long-standing issue which goes back at least as far as the Brigden Committee Report (Brigden et al. 1929). Rather than review the debate on protection here, the reader is referred to Edwards and Watson (1978), Lloyd (1978), and Cobb (1983). Recently this issue received much public attention in Australia when the National Farmers' Federation (1985) made a submission to the prime minister on farm costs. The submission stated that, from the viewpoint of farmers, protection given to Australia's manufacturing industries is easily the costliest of government interventions. Furthermore, the deleterious effects of such protection were claimed to outweigh any government benefits received in the form of fertilizer subsidies, etc., by a considerable margin.[4]

To analyze the impact on Australian agriculture of removing assistance requires an economic model that captures (1) the larger domestic economic environment within which the Australian agricultural sector operates; (2) the vulnerability of the agricultural sector to competition on world markets; and (3) the ability of agriculture to adapt its product mix to changing circumstances. The ORANI model of the Australian economy (developed by Dixon et al. 1982) is ideally suited for such an analysis.[5] ORANI characterizes the operation of the economy in a series of equations describing

1. the demand for commodities and primary factors (labor, capital, and agricultural land) by intermediate and final users;
2. the supply of commodities by domestic producers;
3. the relationship between commodity prices and the costs of production;
4. balances between commodity and factor supplies and their demands; and

5. various descriptors of the macroeconomy (e.g., gross domestic product, the balance of trade, aggregate price indexes) built up explicitly from their microeconomic components.

The equations are derived from microeconomic assumptions about the behavior of producers and final consumers, about technology and household preferences, and about market structures.

ORANI is a computable general equilibrium (CGE) model which represents the latest generation of structurally detailed economywide models. ORANI has a special multiproduct treatment of industries in the agricultural sector which is probably unique among such models.[6] Another novel characteristic of agricultural sector modeling in ORANI is the treatment of the agricultural data base supporting the model. The 1977–78 data base has been augmented using a time series of data from 1967–68 to 1982–83 to reflect typical conditions in the agricultural sector. The notional typical year is interpreted for the most part as an average over a particular period; for example, the average values of shares of returns to land in gross operating surplus are imposed. However, if a significant trend was evident in a share, then the most recent in sample trend value was imposed; this procedure was followed for example, in the case of the share of exports in total sales of live sheep.[7]

An additional noteworthy feature of the version of ORANI used here is its inclusion of equations which describe the distribution of revenue between the public and private sectors. These additional equations comprise the ORANI National and Government Accounts module (NAGA) developed by Meagher (1983, 1984) and by Meagher and Parmenter (1985). Finally, the ORANI model is solved in a linearized form (following Johansen 1960) using GEMPACK, a general purpose software system for CGE models developed at the Impact Project Centre, Melbourne, by Pearson and Codsi (1988).[8]

The rest of this chapter is organized as follows. In the following section a brief description is given of the various forms of assistance given to Australian agriculture and some subsidy equivalent measures of this assistance are presented. In the next section the economic environments assumed for the ORANI simulations are defined. The results are presented in the fourth section. First discussed are the short-run (two-year) effects on key macroeconomic variables. Then the effects on sectoral outputs and farm incomes are studied in detail. Some concluding remarks are offered in the last section.

Finally, an appendix documents some of the technical details involved with the ORANI simulations.

Assistance to Australian Agriculture

The Industries Assistance Commission (IAC) has conducted two major studies of the assistance given to Australian agriculture (see IAC 1983, 1987). These studies found that agricultural assistance is provided through a wide range of measures which increase producers' gross returns either directly by assisting output (e.g., domestic pricing arrangements) or indirectly by assisting the value-adding factors used in the activity (e.g., income tax concessions and drought relief). Assistance is also provided through schemes which reduce input costs (e.g., fertilizer subsidies). In this section a brief discussion is presented of the various types of assistance along with the estimates made by IAC (1987) of the assistance levels for 1984–85, the latest year for which detailed estimates are available. A description of how these different types of assistance are converted into producer subsidy equivalents is given in appendix A.

Assistance to Output

Many Australian agricultural products are assisted by one or more of the following: home consumption pricing schemes; export diversification schemes; export incentive schemes; export inspection services; government purchasing policies; import restrictions (including tariffs, quantitative trade restrictions, and quarantine restrictions); local content schemes; marketing support; price stabilization funds and underwriting arrangements; production bounties; restrictions on substitute products; and sales tax concessions on output. Estimates of the levels of output assistance given to Australian agricultural commodities are given in table 10.1. Rather than discuss these in detail the reader is referred to IAC (1983 and 1987). Here we briefly expand on some of the more significant measures of output assistance.

Domestic pricing arrangements for major export commodities have been the principal form of output assistance to agricultural industries in recent years (see table 10.1, column [I]). These arrangements can provide assistance to producers by maintaining domestic prices above world prices. Home consumption pricing schemes are usually administered through statutory mar-

Table 10.1 Estimates of Assistance Given to Australian Agricultural Commodities ($m 1984–85 prices)

	Assistance to output					
Commodity[a]	Domestic price arrangements [I]	Other assistance [II]	Assistance to value-adding factors [III]	Assistance to inputs[b] [IV]	Total Assistance [I] + [II] + [III] + [IV] [V]	Value of output [VI]
A1. Wool	0.0	27.2	57.1	8.2	92.5	2,288.5
A2. Sheep	0.0	5.1	10.9	1.8	17.8	509.5
A3. Wheat	43.1	4.0	46.5	14.8	108.4	2,836.9
A4. Barley	0.0	0.4	9.2	4.6	14.2	574.5
A5. Other cereal grains						
Maize	0.0	0.0	0.3	0.0	0.3	38.2
Oats	0.0	0.1	2.3	2.3	4.7	161.4
Oil seeds	0.0	0.0	2.5	0.4	2.9	134.5
Rice	8.4	0.0	1.6	0.1	10.1	117.9
Sorghum	0.0	0.1	2.4	0.4	2.9	168.5
Subtotal	8.4	0.2	9.1	3.2	20.9	620.5
A6. Meat cattle	0.0	19.9	78.9	29.6	128.4	2,075.0
A7. Milk cattle and pigs						
Manufacture	122.5	6.5	13.2	1.2	143.4	509.6
Market	220.0	6.6	13.6	1.2	241.4	528.8
Pigs	0.0	0.2	5.2	−23.1	−17.7	406.1
Subtotal	342.5	13.3	32.0	−20.7	367.1	1,444.5
A8. Other farming (sugarcane, fruit and nuts)						
Apples and pears	4.4	1.2	2.9	0.1	8.6	177.0
Bananas	0.5	0.0	1.2	0.0	1.7	73.5
Citrus	0.0	24.1	2.0	0.1	26.2	123.4
Deciduous canned fruits	2.5	0.1	0.9	0.1	3.6	18.9
Dried vine fruits	13.0	0.2	1.4	0.1	14.7	76.4
Sugarcane	68.2	0.3	8.7	2.3	79.5	515.3
Subtotal	88.6	25.9	17.1	2.7	134.3	984.5
A9. Other farming (vegetables, cotton, oil seeds and tobacco)						
Cotton	7.0	0.0	5.8	0.2	13.0	326.4
Honey	0.2	0.1	0.3	0.0	0.6	21.0
Onions	0.0	0.5	0.3	0.0	0.8	38.8
Potatoes	0.0	10.1	1.1	0.2	11.4	136.1
Tobacco	0.0	17.1	1.1	0.0	18.2	63.4
Tomatoes	0.0	1.1	0.7	0.1	1.9	80.2
Other vegetables	0.0	1.6	1.0	0.2	2.8	119.2
Subtotal	7.2	30.5	10.3	0.7	48.7	785.1

Table 10.1 continued

Commodity[a]	Assistance to output: Domestic price arrangements [I]	Assistance to output: Other assistance [II]	Assistance to value-adding factors [III]	Assistance to inputs[b] [IV]	Total Assistance [I] + [II] + [III] + [IV] [V]	Value of output [VI]
A10. Poultry						
Eggs	24.8	0.1	2.7	−8.2	19.4	233.6
Poultry	0.0	0.0	8.9	−25.0	−16.1	510.3
Subtotal	24.8	0.1	11.6	−33.2	3.3	743.9
Total	514.6	126.6	282.7	11.7	935.6	12,862.9

[a] For a detailed description of the subcategories of the ORANI agricultural commodity classifications see Higgs (1986, table 1.2).
[b] Note that this excludes tariffs on materials and capital, which act as a negative form of assistance.
Source: Industries Assistance Commission (1987).

keting authorities, supported by restrictions placed on imports of the commodity, and are exempt from the Trade Practices Act which would otherwise declare such schemes illegal.[9]

The other major form of output assistance is marketing support. The Australian government assists in the promotion of agricultural products. The largest grants in this category have been to wool.

Assistance to Value-adding Factors

Australian agricultural producers may be assisted by one or more of the following: adjustment assistance, agricultural extension services, agricultural research, concessional credit, income taxation concessions, income equalization deposits, and natural disaster relief. Again, these are only briefly discussed here. Adjustment assistance and concessional credit both refer to schemes whereby finance is made available to farmers at subsidized interest rates. Extension services are agricultural advisory services which, along with agricultural research, are supported by government funds. Significant income tax concessions are available to primary producers which are not available to other taxpayers. The three main tax concessions are (1) the ability to depreciate certain capital items not depreciable for most commercial taxpayers, or to depreciate certain capital items at higher than scheduled rates; (2) the ability to defer certain income to subsequent financial years;

and (3) tax averaging. Finally, direct assistance in the form of grants or concessional loans may be made available in the event of natural disasters such as cyclones, floods, bushfires, and droughts.

Assistance to Inputs

Assistance is given to inputs to the agricultural industries in the form of disease control, fertilizer subsidies, and sales tax concessions. The value of such assistance is relatively small; the most significant items in 1984–85 were subsidies for the input of phosphatic and nitrogenous fertilizers. These have since been discontinued.

Assumed Economic Environment

Certain features of the economy are not projected endogenously by ORANI. For these, the user of the model must specify an environment before computing a solution. In other words, there are more variables than equations in the model; therefore, the user must set values for some of the variables exogenously so that the number of unknown variables equals the number of equations.

The key features of the economic environment are as follows.[10] It is assumed that there are no shortages of labor at the going real wage rates.[11] Thus employment levels are demand determined. It is assumed that plant and equipment in use in every industry do not change (from the levels they otherwise would have reached) because of the shock under analysis (i.e., industry capital stocks in use are exogenous). Note that the short-run time period simulated allows for revisions in all industries' investment plans, for orders for capital goods to be placed and met, and for the new plant and equipment to be installed (but not yet switched on). The length of the short run in ORANI has been estimated by Cooper (1983) as 7.9 quarters. In policy work "about two years" is the appropriate level of precision for describing the ORANI short run. Next, the ORANI model does not distinguish between changes in the relative prices of traded and nontraded goods brought about on the one hand by a change in the nominal exchange rate, or on the other hand by a change in the domestic price level. Here it is assumed that induced changes in the real exchange rate appear as changes in the domestic price level. In other words, the nominal exchange rate is the numeraire. Finally, it is assumed that both tax rates and real government expenditure are exogenous and, with the exception of tariffs, set to zero change. Thus if a shock leads to an increase in real government income, then, under these assumptions, there will be a fall in the real public sector borrowing requirement.

Effects of the Removal of Assistance to Australian Agricultural and Manufacturing Industries

In this section we discuss the results of ORANI simulations of the effects of the removal of assistance to Australian agricultural and manufacturing industries. To simulate the effects of the removal of assistance to agriculture, the input costs of the agricultural industries were increased to the extent of estimated producer subsidy equivalents.[12] Where the subsidy is in the form of home consumption pricing schemes, the prices of some key downstream sales were adjusted to capture the appropriate fall in agricultural prices that would occur if these schemes were disbanded. To simulate the effects of the removal of assistance to manufacturing industries, the nominal rates of protection for Australian manufacturing industries for 1986–87 were removed.[13] These are estimates of the extent to which tariff and quota protection raised the domestic prices of imported goods.

Macroeconomic Projections

The short-run effects of the removal of assistance to agricultural and manufacturing industries on some nominal aggregates are given in table 10.2. The table also gives the reader a feel for the size of the Australian economy. The estimated impacts on the macroeconomic aggregates reported in Table 10.2 can be used to study the effects of removing trade distortions in terms of the sectoral balances identity. The latter may be written

$$(E-M)=(S-I)+(T-G) \tag{1}$$

where E and M, respectively, are exports and imports; S and I, respectively, are private savings and private investment; and T and G, respectively, are government income and government expenditure. Equation (1) says that if Australia absorbs more resources than it produces (i.e., if I exceeds S, and/or if G exceeds T) then the balance of trade must move towards deficit. The first thing to note is that in the base period the data satisfies the sectoral balances identity. This can be checked by substituting the appropriate values from the first column of table 10.2 into equation (1).

Table 10.2 Projections for Some Nominal Aggregates

Variable	Base period $m 1984–85 prices	Projected change in $m Removal of subsidy equivalents to the agricultural sector [I]	Removal of protection from imports for the manufacturing sector [II]	[I] + [II] [III]
Exports (E)	34,148	– 626	1,839	1,213
Imports (M)	39,005	– 326	2,440	2,114
Private consumption (C)	125,967	– 1,551	– 4,615	– 6,166
Private investment (I)	36,499	– 390	– 1,707	– 2,097
Government expenditure[a] (G)	52,136	– 524	– 2,463	– 2,987
Government outlays[b] (G*)	86,535	– 1,163	– 4,198	– 5,361
Government income (T)	71,417	– 919	– 4,400	– 5,319
Public sector borrowing requirement[c] (PSBR)	15,118	– 244	202	– 42
Private savings (S)	12,361	– 295	– 371	– 665
Gross Domestic Product (Y)	209,745	– 2,765[d]	– 9,386[d]	– 12,150[d]

Note: Note that columns I, II, and III contain the dollar values of deviations from control expected to occur about two years after the imposition of the shocks. These deviations reflect both price and quantity effects. Hence the dollar amounts in these columns correspond to the thought experiment in which, in the absence of the shock(s), the aggregate values of the variables are arbitrarily scaled to their 1984–85 values; the deviations from these values depend partly on the fact that the shock(s) are expected to be deflationary (i.e., to make prices lower than they would otherwise have been), and partly on quantity effects. The key price and quantity effects are shown in table 10.3.

[a] This refers to government consumption plus government investment.

[b] This refers to all government outlays including government expenditures and transfer payments.

[c] Note that PSBR = G* – T, which in turn equals the negative of government savings.

[d] Note that these negative entries do not necessarily indicate falls in real magnitudes; see table 10.3.

Removal of agricultural assistance. The projected changes in terms of millions of Australian dollars at 1984–85 prices due to the removal of subsidy equivalents to the agricultural sector are given in column [I] of table 10.2. These results can be explained as follows. The removal of the subsidy equivalents has an impact effect of causing a contraction in the agricultural sector. As agriculture is a significant export sector, the contraction in agriculture results in a decline in exports. In terms of equation (1), this corresponds to a fall in E. The revenue saved by the government through removing its assistance to agriculture is assumed not to be redistributed; rather it shows up here as an improvement in the public sector borrowing requirement (PSBR). As a result, the contraction in the agricultural sector leads to a decline in the nominal (and, as we shall see, also the real) size of the economy. This tends to cause a reduction in imports, M. However, before any conclusions can be reached about the final impact on the balance of trade we must study the effect on relative prices.

Table 10.3 contains projections for some key price indices and real macroeconomic variables. As simulated here, the removal of assistance to agriculture is deflationary owing to both the removal of the home consumption pricing schemes and the contraction in the size of the economy. All of the price indices in column [I] of table 10.3 are projected to fall. The consumer price index (CPI) is projected to fall the most; this is due to the removal of the home consumption pricing schemes for agricultural products which have larger weights in the CPI relative to the other price indices. As wages are assumed to be fully indexed to the CPI, the fall in the CPI causes a fall in nominal wages. This in turn improves the competitiveness of the internationally traded sectors. This improvement in competitiveness partially offsets the decline in aggregate exports brought about by the contraction in agriculture. Aggregate imports are projected to decline owing to both the contraction in the size of the economy and the improvement in competitiveness of the domestic import-competing sectors. However, the decline in exports dominates and the balance of trade (i.e., E – M) moves $300 million (1984–85 prices) toward deficit. As the economy is absorbing more resources than it produces we would expect I to exceed S and/or G to exceed T.

Next we look at the effects on government income and expenditure. As government expenditure is assumed to remain constant in real terms, nominal government expenditure falls by $524 million (1984–85 prices). However the income collected by the government also falls, in this case by $919 million. On balance (T – G) is projected to decline by $395 million. This exceeds the above fall in the balance of trade by $95 million. Thus we would expect (S – I) to increase by $95 million.

It is assumed that the percentage change in real private investment is equal to the percentage change in real disposable income. As the size of the economy declines this tends to cause a fall in real disposable income and hence in real private investment (see table 10.3, column [I]). It can be seen from column [I] of table 10.2 that nominal private investment falls by $390 million (1984–85 prices), which is $95 million more than the projected fall in private savings.

Finally, real GDP and aggregate employment are both projected to decline

Table 10.3 Macroeconomic Projections

Variable	Removal of subsidy equivalents to the agricultural sector [I]	Removal of protection from imports for the manufacturing sector [II]	[I] + [II] [III]
Consumer Price index (CPI)	−1.0	−4.8	−5.8
Investment Price Index (IPI)	−0.9	−5.8	−6.7
Government Price Index (GPI)	−1.0	−4.8	−5.7
Factor cost GDP deflator (FCGDP)	−0.9	−4.6	−5.5
Aggregate exports (foreign currency value)	−1.8	5.4	3.6
Aggregate imports (foreign currency value)	−0.8	6.3	5.4
Balance of trade	−0.1	−0.3	−0.4
Real private consumption	−0.2	1.1	0.9
Real private investment	−0.2	1.1	0.9
Real GDP[a]	−0.4	0.7	0.3
Aggregate employment[b]	−0.5	0.9	0.4
Real pretax wage rate (FCGDP deflated)	−0.1	−0.2	−0.3
Government expenditure[c]	−1.0	−4.7	−5.7
Government outlays[d]	−1.3	−4.9	−6.2
Government income	−1.3	−6.2	−7.5
Public sector borrowing requirement[e]	−1.6	1.3	−0.3

Note: All projections, with the exception of the balance of trade, are percentage deviations from the value the variable in question would have taken in the absence of the shock at the head of the column. The balance of trade, while also a deviation from control, is expressed as the change in the balance of trade divided by the base-period GDP.

[a] Real GDP is calculated here as a weighted sum of industry output responses using value-added weights.

[b] This is calculated by weighting the employment by occupation projections by persons weights.

[c] This refers to government consumption plus government investment.

[d] This refers to all government outlays including government expenditures and transfer payments.

[e] This is equal to government outlays less government income.

slightly if assistance to agriculture is removed (see table 10.3, column [I]). These results largely follow from our assumption that the revenue saved by the government is used to reduce the PSBR rather than being redistributed via, say, tax cuts. The PSBR is projected to decline by $244 million (1984–85 prices). The real wage rate as a cost to employers of labor (i.e., the pretax wage rate factor cost GDP deflated) is projected to fall slightly. This stimulates employment and so partially offsets the decline in aggregate employment brought about by the contraction in the real size of the economy.

Removal of manufacturing protection. We now examine the projected changes due to the removal of protection from imports for the manufacturing sector. The removal of tariffs has an effect of lowering the price to domestic purchasers of imported goods. Thus imports will increase as domestic purchasers switch toward the now cheaper imported goods. Furthermore, the fall in import prices causes a decline in the CPI. As wages are assumed to be fully indexed to the CPI, the decrease in the CPI flows on into wages and then back into further price reductions, etc. The end result is a 4.8 percent decrease in the CPI. The other price indices in column [II] of table 10.3 are also projected to decrease, with the largest decline occurring in the investment price index (IPI). The IPI is projected to decline slightly more because of its relatively heavier weights for imported investment goods whose prices are projected to fall significantly if nominal rates of protection are removed. The falls in these price indices improve the competitiveness of the traded sectors. This tends partially to offset the above increase in imports. However, the removal of protection for manufacturing also causes an expansion in the size of the economy, which causes an increase in imports. On balance, aggregate imports are projected to increase by $2,440 million (1984–85 prices). Aggregate exports are projected to increase by $1,839 million, owing to the improvement in competitiveness. The increase in imports exceeds the increase in exports and the balance of trade is projected to move $601 million toward deficit.[14]

The deflationary effect of the tariff cut means that nominal government expenditure (which is assumed to remain constant in real terms) falls by $2,463 million (1984–85 prices). Government income is also projected to fall, in part due to the loss of tariff revenue, by $4,400 million.[15] On balance (T – G) is projected to decline by $1,937 million. This exceeds the above fall in the balance of trade by $1,336 million. Thus we expect (S – I) to increase by $1,336 million.

The removal of manufacturing protection causes a small increase in real consumption and investment (see table 10.3, column [II]). Under our closure of the model, this would tend to increase nominal investment. However, the fall in the IPI (see table 10.3, column [II]) dominates and nominal investment is projected to decline by $1,707 million (1984–85 prices). Finally, private savings is projected to fall by $371 million. Thus (S – I) increases by the expected $1,336 million.

The removal of protection from imports for the manufacturing sector causes a small increase in aggregate employment and real GDP (see table 10.3, column [II]). On the other hand, as simulated here, it also causes an increase in the PSBR.

The combined effect. Column [III] of tables 10.2 and 10.3 shows the total effect of the removal of assistance to agricultural and manufacturing industries. Note that as the model is solved as a linear system, the total effect is simply given by the addition of columns [I] and [II]. It can be seen from table 10.3 that the total package is projected to cause a fall in domestic price indices. Both aggregate exports and aggregate imports are projected to increase, with a small decline in the balance of trade. However, real aggregate consumption and investment are projected to increase slightly, as are real GDP and aggregate employment. Furthermore, a small decrease in the PSBR is projected if assistance to both agricultural and manufacturing industries is removed.

Sectoral Output Projections

The short-run effects of the removal of assistance on industry outputs are given in table 10.4. The industries have been divided into four broadly defined groups: export, export-related, import-competing, and nontraded.

Removal of agricultural assistance. It can be seen from table 10.4, column [I] that, not surprisingly, the agricultural sector is projected to decline if its levels of assistance are removed. (The results for each of the individual agricultural industries are discussed in detail in the next section.) The resulting increase in agricultural prices causes a decline in the outputs of the agricultural processing industries, meat products, other food products, and cotton ginning, wool scouring, and top making. As the removal of the subsidies is deflationary the international competitiveness of the industries in the mining sector improves. Thus we observe projected increases in the outputs of the mineral export industries. With the exceptions of services to mining and water transport, all of the export-related industries are projected to decline in output. This is largely caused by reduced demand from agriculture for their products or services. The next group of industries compete (to varying extents) with imports. Even though these industries are now slightly more competitive, given the projected fall in domestic costs, they are projected on

Table 10.4 Sectoral Output Projections

Industry	Removal of subsidy equivalents to the agricultural sector [I]	Removal of protection from imports for the manufacturing sector [II]	[I] + [II] [III]
Export			
1–8 Agriculture[a]	−2.5	3.4	0.9
12 Ferrous metal ores	−0.7	3.8	4.5
13 Nonferrous metal ores	1.0	4.9	5.9
14 Black coal	1.2	6.0	7.3
18 Meat products	−3.4	6.0	2.6
25 Other food products	−10.6	11.0	0.5
30 Cotton ginning, wool scouring and top making	−1.7	2.3	0.6
64 Nonferrous metals	1.2	5.9	7.1
Export related			
9 Services to agriculture	−2.4	2.8	0.4
11 Fishing and hunting	−1.0	1.5	0.5
16 Other minerals	−0.0	1.1	1.1
17 Services to mining nec	3.2	1.9	5.1
49 Chemical fertilizers	−2.2	3.3	1.1
70 Railway rolling stock	−0.1	1.3	1.2
76 Agricultural machinery	−17.5	20.7	3.1
93 Road transport	−0.7	1.3	0.6
94 Rail and other transport	−0.4	1.8	1.5
95 Water transport	0.0	1.4	1.4
Import competing			
19 Milk products	0.8	−0.5	0.4
20 Fruit and vegetable products	−0.4	0.1	−0.3
21 Margarine, oils, and fats nec	−0.5	0.2	−0.3
22 Flour and cereal products	−0.5	0.7	0.2
23 Bread, cakes, biscuits	−0.1	0.2	0.2
24 Confectionery and cocoa	0.1	−0.8	−0.7
28 Other alcoholic beverages	−0.7	−2.8	−3.4
29 Tobacco products	−0.1	0.6	0.5
31 Man-made fibers, yarns	1.4	−29.2	−27.8
32 Cotton yarns, fabrics	1.1	−22.3	−21.3
33 Wool, worsted fabrics	0.0	−5.5	−5.5
34 Textile finishing	0.1	−4.7	−4.6
35 Textile floor coverings	0.0	−5.0	−5.0
36 Other textile products	−0.2	−1.3	−1.5
37 Knitting mills	0.2	−10.1	−9.9
38 Clothing	0.2	−8.4	−8.2
39 Footwear	0.8	−40.1	−39.3
40 Sawmill products	0.2	0.5	0.7

Table 10.4 continued

Industry	Removal of subsidy equivalents to the agricultural sector [I]	Removal of protection from imports for the manufacturing sector [II]	[I] + [II] [III]
41 Veneers and wood boards	0.1	− 1.4	− 1.3
42 Joinery and wood products nec	0.1	− 0.0	0.0
43 Furniture and mattresses	0.2	− 0.9	− 0.8
44 Pulp, paper, paperboard	− 0.1	− 0.7	− 0.8
45 Bags and containers	− 0.9	0.9	0.0
46 Paper products nec	− 0.3	− 0.9	− 1.2
47 Newspapers and books	− 0.0	1.2	1.2
48 Commercial printing	− 0.3	0.4	0.1
50 Other basic chemicals	0.4	− 4.3	− 3.9
51 Paints, varnishes	0.1	− 2.3	− 2.2
52 Pharmaceutical goods	− 0.5	1.2	0.7
53 Soap and detergents	− 0.3	0.4	0.1
54 Cosmetics and toiletries	− 0.0	0.7	0.7
55 Other chemical goods	0.1	− 0.9	− 0.9
56 Petrol and coal products	− 0.3	1.0	0.6
57 Glass and glass products	− 0.0	− 0.6	− 0.6
58 Clay products, refractories	− 0.0	1.3	1.3
62 Nonmetallic mineral products	− 0.1	0.7	0.6
63 Basic iron and steel	0.0	− 1.1	− 1.1
65 Structural metal products	− 0.0	0.5	0.5
66 Sheet metal products	− 0.4	0.2	− 0.2
67 Other metal products	0.4	− 3.5	− 3.1
68 Motor vehicles and parts	0.7	− 13.2	− 12.5
69 Ships and boats	1.3	− 1.1	0.2
71 Aircraft	1.0	0.7	1.7
72 Scientific equipment	0.0	0.8	0.8
73 Electronic equipment	0.6	− 4.1	− 3.6
74 Household appliances	− 0.2	− 1.2	− 1.4
75 Other electrical goods	0.8	− 2.0	− 1.2
77 Construction machinery	2.3	− 1.2	1.2
78 Other machinery	0.8	− 1.1	− 0.3
79 Leather products	0.3	− 15.7	− 15.4
80 Rubber products	0.1	− 4.0	− 3.9
81 Plastic products	− 0.3	− 3.1	− 3.4
82 Signs, writing equipment	0.1	− 1.2	− 1.2
83 Other manufacturing	0.2	− 2.2	− 2.0
Nontraded			
10 Forestry and logging	2.6	− 2.1	0.5
15 Oil, gas, and brown coal	0.1	0.4	0.5
26 Soft drinks, cordials	− 0.2	0.3	0.1
27 Beer and malt	− 0.1	0.9	0.7

Table 10.4 continued

Industry	Removal of subsidy equivalents to the agricultural sector [I]	Removal of protection from imports for the manufacturing sector [II]	[I] + [II] [III]
59 Cement	−0.2	1.1	0.9
60 Ready mixed concrete	−0.3	1.0	0.8
61 Concrete products	−0.2	1.0	0.8
84 Electricity	−0.2	0.8	0.6
85 Gas	−0.2	0.2	0.1
86 Water, sewerage, drainage	−0.3	0.6	0.3
87 Residential building	−0.2	1.0	0.8
88 Other construction	−0.3	1.1	0.8
89 Wholesale trade	−0.8	1.2	0.4
90 Retail trade	−0.2	1.3	1.1
91 Mechanical repairs	−0.3	1.6	1.3
92 Other repairs	−0.3	1.7	1.4
96 Air transport	−0.1	2.0	1.9
97 Communication	−0.3	0.9	0.6
98 Banking	−0.2	0.6	0.4
99 Nonbank finance	−0.2	0.6	0.4
100 Investment and services	−0.2	0.5	0.3
101 Insurance	−0.2	1.2	1.0
102 Other business services	−0.3	0.8	0.4
103 Ownership of dwellings	0.0	0.0	0.0
104 Public administration	−0.1	0.1	0.1
105 Defense	0.0	0.0	0.0
106 Health	−0.1	0.9	0.8
107 Education, libraries	−0.0	0.1	0.1
108 Welfare services	−0.1	0.6	0.5
109 Entertainment, leisure	−0.3	1.1	0.8
110 Restaurants, hotels	−0.2	1.3	1.0
111 Personal services	−0.2	1.3	1.1
112 Noncompeting imports	−0.0	−0.0	−0.0

Note: All projections are percentage deviations from what the output of the sector would have been in the absence of the shock at the head of the column.

[a] The agricultural sector's results are disaggregated in table 10.5.

average to experience a small decline in output. This is due to the contraction in the size of the economy. Note that the milk products industry experiences an increase in output. This is due to the dismantling of the home consumption pricing scheme for milk. The final group of industries is classified as nontraded. These industries do not have any real scope for replacing imports and therefore, with a few exceptions, they experience declines in output. Note that industries which sell mainly to the government sector (104–108) do worse than average because of the fall in government spending (table 10.3).

Removal of manufacturing protection. Column [II] of table 10.4 shows the sectoral effects of the removal of protection for manufacturing industries. Recall from table 10.2 that the removal of protection is deflationary, and so improves the competitiveness of the traded sectors. As a result, all of the export and export-related industries are projected to experience an increase in output. Overall the import-competing industries decline owing to the removal of their protection from imports. This is particularly true for industries 31–39 (which constitute the textiles, clothing, and footwear sector) and industry 68, the motor vehicles and parts industry. Note that some of the import-competing industries actually benefit from the across-the-board removal of protection. This is due first of all to their improved competitiveness via the lowering of domestic costs; second, to the increase in real absorption; and third, to their links (where applicable) to the export sector. The nontraded industries in general experience a small increase in output due to the removal of protection. These industries largely benefit from the increase in real consumption and investment that occurs.

The combined effect. Column [III] of the table shows the total effect of the removal of assistance to agricultural and manufacturing industries. All of the export (including agricultural) and export-related industries benefit from the total package. The big losers are the textiles, clothing, and footwear sector and the motor vehicles and parts industry. On average, relatively small increases are projected for the nontraded industries.

Agricultural Output Projections

The short-run effects of the removal of assistance on agricultural industry outputs are given in table 10.5. It can be seen from column [I] of the table that all the agricultural industries are projected to experience declines in output if the subsidies to agriculture are removed. The differential responses between the industries can be explained using the ORANI short-run supply function, which for industry j can be written[16]

$$z_j = \lambda_j(p_j - \psi_j) \tag{2}$$

where

$$\lambda_j = \sigma(1 - S_{Fj})/(S_{Fj}H_{Xj}) \tag{3}$$

In these equations the percentage change in industry j's output is represented by z_j ; p_j is the percentage change in the farm-gate price of industry j's output (this is an appropriately weighted index for the multiproduct industries); ψ_j is the percentage change in an index of costs to industry j; σ is the elasticity of substitution between primary factors (assumed to be 0.5 for all industries in the short run); S_{Fj} is the share of the fixed factors in industry j's primary-factor inputs; and H_{Xj} is the share of primary-factor inputs in industry j's total costs.

Equation (2) suggests that we need look only at three influences to determine an industry's output response. The first is λ_j which, according to equation (3), is determined by base-period shares and an elasticity. The second is the change in the industry output price, and the third is an index of costs. The greater the fixed-factor share, S_{Fj}, and the primary-factor share, H_{Xj}, the less responsive is the industry (i.e., the smaller is λ_j). For the three zonal industries the λ_j's are as follows: $\lambda_1 = 0.75$, $\lambda_2 = 0.57$, and $\lambda_3 = 0.92$. Thus, given equal changes in output prices over costs, of the zonal industries we would expect the high rainfall zone ($j = 3$) to be the most responsive, followed by the pastoral zone ($j = 1$), and finally by the wheat-sheep zone ($j = 2$).

Removal of agricultural assistance. The subsidies to the pastoral, wheat-sheep, and high rainfall zones, as a percentage of total costs are, respectively, 4.32 percent, 4.55 percent, and 4.90 percent. Thus the changes in costs to the zonal industries (ψ_j) due to the removal of these subsidies are fairly similar. Furthermore, as the zonal industries' output is largely sold as exports, and as the export demand schedules faced are fairly flat, these industries will be unable to pass on the cost increases induced by the removal of the subsidies to any significant extent. As a result the changes in output prices (p_j) will be small and roughly equal for each of the zones. Consequently, the changes in the price-cost ratios ($p_j - \psi_j$) will not differ greatly between zones. Hence the relative responses suggested by the λ_j's are indeed evident in the projections listed in column [I] of table 10.5. Finally, if we make the crude approximations (for the purpose of this back-of-the-envelope

Table 10.5 Agricultural Output Projections

Industry	Removal of subsidy equivalents to the agricultural sector [I]	Removal of protection from imports for the manufacturing sector [II]	[I] + [II] [III]
1 Pastoral zone	−1.6	3.1	1.5
2 Wheat-sheep zone	−1.3	2.7	2.8
3 High rainfall zone	−2.1	3.9	1.7
4 Northern beef	−4.0	6.3	2.4
5 Milk cattle and pigs	−1.2	1.8	0.6
6 Other farming (sugarcane, fruit, and nuts)	−6.8	6.4	−0.3
7 Other farming (vegetables, cotton, oil seeds, and tobacco)	−2.5	1.8	−0.7
8 Poultry	−1.8	3.2	1.4
Agriculture	−2.5	3.4	0.9

Note: All projections are percentage deviations from what the industry outputs would have been in the absence of the shock at the head of the column.

calculation) that the output price of, say, the pastoral zone did not change (i.e., $p_1 = 0$) and that this industry's costs increased by just the direct effect of its own subsidy removal (i.e., $\psi_1 = 4.32$), then according to equation (2) the output of the pastoral zone would decline by roughly 3 percent (i.e., $0.75 \times (0 - 4.32)$), whereas the projected decline is 1.6 percent. The main reason for the back-of-the-envelope approach overestimating the decline is its failure to account for the second-round effects on costs due to the fall in the CPI and hence in nominal wages.

The northern beef industry produces only meat cattle, which is largely exported after being processed by the meat products industry. As a result, it is not generally true that the price of unprocessed meat is determined solely on world markets. However as processing costs are not projected to change significantly here, it turns out that the price of meat cattle only changes by −0.9 percent. The subsidy to the northern beef industry as a percentage of total costs is equal to 6.19 percent. The λ_j for the northern beef industry is equal to 0.67. If we again make the assumption that this industry's costs increased by just its *own* subsidy removal, then according to equation (2) the output of the northern beef industry would decrease by roughly 4.75 percent (i.e., $0.67 \times (-0.9 - 6.19)$), whereas the projected decline is 4.0 percent. The back-of-the-envelope approach again slightly overestimates the decline due to its failure to account for second-round effects on costs.

The subsidy to the milk cattle and pigs industry is equal to 24.25 percent of the total costs of the industry. As a percentage of total costs this is by far the largest subsidy to the agricultural industries. However, the output of the milk cattle and pigs industry is projected to decline by only 1.2 percent when the subsidies are removed. This is because milk cattle and pigs sell primarily to the domestic market and can pass on nearly all of the cost increase. In fact the price of the commodity milk cattle and pigs is projected to increase by 24.2 percent. The λ_j for the milk cattle and pigs industry is equal to 1.11. As 93 percent of the output of the milk cattle and pigs industry consists of the commodity "milk cattle and pigs," we could reckon that this industry's output price increased by about 22.5 percent (i.e., 0.93×24.2). Furthermore, if we assumed that its costs increased by 24.3 percent, then according to equation (2), the output of the milk cattle and pigs industry would decline by roughly 2 percent (i.e., $1.11 \times (22.5 - 24.25)$). This is about double the actual projection: the difference once again is due to second-round effects under which nominal wages are reduced because of the fall in the CPI.

The largest percentage decline in output occurs in the other farming (sugarcane, fruit, and nuts) industry. The subsidy to this industry is equal to 13.64 percent of its total costs. This represents the second largest subsidy as a percentage of total costs to an agricultural industry. However, unlike the milk cattle and pigs industry, which receives the largest subsidy, roughly half of the output of the other farming industry is exported after being sent to a food-processing sector. Thus the other farming industry is unable to pass on all the cost increases it would incur if the subsidies given to it were removed. As a result it is projected to experience a 6.8 percent decline in output if the agricultural subsidies are removed.[17]

The other farming (vegetables, cotton, oil seeds, and tobacco) industry sells to a number of sectors of the economy. If the subsidies are removed, then this industry is projected to decline by 2.5 percent. This is partially due to the decline in real consumption (see table 10.2, column [I]).[18]

The last agricultural industry to be discussed is poultry. Although the subsidy to the poultry industry is only equal to 0.44 percent of total costs to the industry, the removal of agricultural subsidies is projected to cause a decline of 1.8 percent in the poultry industry. This can be explained as follows. The poultry industry sells about half of its output to the export-oriented meat products sector. The decline in the output of the poultry industry is largely due to the contraction in the meat products sector.[19]

Removal of manufacturing protection. Column [II] of table 10.5 shows the effects on agricultural ouputs of removing protection from the manufacturing sector. All of the agricultural industries are projected to experience an increase in output. However, the benefits to the agricultural sector are not uniform across the agricultural industries. The differential responses between the industries can again be explained by making reference to equation (2). First we make the approximation that the change in costs to the agricultural industries is equal to the change in the factor cost GDP deflator of -4.6 percent (see table 10.2, column [II]). (In other words, we assume that ψ_j is equal to -4.6 for $j = 1, \ldots, 8$.) Next we assume (for the purpose of this back-of-the-envelope calculation) that the output prices of the zonal industries do not change (e.g., for the pastoral zone, $p_1 = 0$). Thus according to equation (2), the output of the pastoral zone will increase by about 3 percent (i.e., $0.75 \times (0 - -4.6)$) which is an agreement with the projected increase of 3.1 percent. The projections for the wheat-sheep and high rainfall zones can be explained in a similar fasion.

The northern beef and other farming (sugarcane, fruit, and nuts) industries benefit the most from the removal of protection to the manufacturing industries. As mentioned above, both of these industries sell a significant amount of their output to food-processing sectors which then export their produce. The reduction in domestic costs, especially wages, improves the competitiveness of the food-processing sectors, which in turn results in significant gains to the agricultural producers.

The milk cattle and pigs industry and the other farming (vegetables, cotton, oil seeds, and tobacco) industry both sell largely to the domestic market. These industries benefit from the projected increase in real consumption. They also sell a small percentage of their output to the processing industries which are stimulated by the reduction in domestic costs. As a result these industries are only projected to experience relatively small increases in output. Finally, the poultry industry is projected to experience a 4.4 percent increase in output. This is largely due to increased demand from the meat products sector.

The combined effect. It can be seen from column [III] of table 10.5 that, with the exceptions of small declines in the two other farming industries, the agricultural industries are projected to experience a net increase in output if assistance to both agricultural and manufacturing industries is removed.

Conclusions

Removing assistance to both agricultural and manufacturing industries would result in an increase in aggregate employment, an increase in real GDP, and allow the government to reduce the public sector borrowing requirement. Furthermore, the net effect on the agricultural sector would be an increase in farm output. Thus, on balance, Australia is actually taxing its agricultural sector with its current set of trade distortions. On the other hand, the net effect is a decline in output in some of the import-competing sectors. Of note are the declines projected for the textiles, clothing, and footwear sector and the motor vehicle and parts industry.

In future research this study could be extended in a number of areas. Not all distortions that affect trade have been removed here. For example, distortions in the area of transport can have a significant effect on agricultural exports; however, we have not studied these. Furthermore, the net benefits from reducing agricultural assistance are underestimated, to the extent that the reduction would be associated with the rationalization of some agricultural industries via the removal of cumbersome government regulations.

Finally, the results presented in this chapter may be of particular interest given the following statement made by Australia's prime minister, Mr. Hawke, in an address to the contracting parties of the GATT in Geneva on 22 October 1987:

> We are prepared to negotiate a broad package of measures to reduce overall levels of effective assistance to Australian industry—including tariffs—as part of a broad-based multilateral approach. In this context, we are prepared to eliminate, over an appropriate implementation phase, all quantitative import measures designed to protect domestic industry. This means we would phase out all our quantitative restrictions, including tariff quotas, licensing, and embargoes. This is a radical approach—but it is the kind of radical approach necessary to provide the world with its best chance to capture fully the potential gains from trade.

Appendix A

This appendix contains three sections. The first documents the closure and the nominal rates of protection used for the ORANI simulations. The second describes the method used to calculate the size of the exogenous shocks when simulating the removal of assistance to agriculture. The third section

Table 10A.1 Set of Exogenous Variables for the ORANI Simulations

Exogenous variable	Subscript range	Number	Description
ORANI variables^{a,d}			
$p^{m}_{(i2)}$	$i=1,\ldots,g.$	g	Cif foreign currency import prices
$t(i2,0)$, $v(i2,0)$	$i=1,\ldots,g.$	$2g$	Tariff terms
$t(is,jk)$, $v(is,jk)$	$i=1,\ldots,g,$ $s,k=1,2,$ $j=1,\ldots,h$	$8g$	Ad valorem and specific sales-tax terms
$t(is,3)$, $v(is,3)$	$i=1,\ldots,g.$ $s=1,2.$	$4g$	
$v(i1,4)$	$i \in G.^{b}$	g	Selection of specific export tax terms and complementary selection of export volumes
$x^{(4)}_{(i1)}$	$i \notin G.$		
$t(i1,4)$	$i=1,\ldots,g.$	g	Ad valorem export tax terms
a's (excluding a(j))	subscript ranges can be read from table 23.2 in DPSV	$4g^2h+5g^2+7gh+Mh+8h+3g+\sum_{j=1}^{h}N(j)$	Technological changes and changes in household preferences
$k_j(0)$	$j=1,\ldots,h.$	h	Current capital stocks
n_j	$j=1,\ldots,h.$	h	Use of agricultural land in each industry
$f^{(1)}_{(g+1,1)}$		1	Wage shift variables
$f^{(1)}_{(g+1,1,m)}$	$m=1,\ldots,m.$	M	
$f^{(1)}_{(g+1,1),j}$	$j=1,\ldots,h.$	h	
$f^{(1)}_{(g+1,1,m)j}$	$m=1,\ldots,M.$ $j=1,\ldots,h.$	Mh	
$f^{(5)}_{(is)}$	$i=1,\ldots,g.$ $s=1,2.$	$2g$	"Other" demand shift terms
$f^{(2)}_{j}$	$j \notin J.^{c}$	$h-J^{*}$	Exogenous investment
f^{e}_{i1}	$i=1,\ldots,g.$	g	Shifts in foreign export demands
$f^{(1)}_{g+2j}$	$j=1,\ldots,h$	h	Shifts in the price of "other cost" tickets
q		1	Number of households
ϕ		1	The exchange rate \$A per U.S.\$, for example

Table 10A.1 continued

Exogenous variable	Subscript range	Number	Description
NAGA variables[e]			
f_R		1	The ratio of real private investment expenditure to real household consumption expenditure
g_R		1	Real government consumption expenditure
θ		1	Shock control variable
α_p		1	Payroll tax rate
α_V		1	VAT tax rate
α_L		1	Labor income tax rate
α_K		1	Capital income tax rate
f_w		1	Shift variable wage indexation

Total $4g^2h + 5g^2 + 15gh + 2Mh + 13h + 15g + M + \sum_{j=1}^{h} N(j) + 11 - J^* = 6{,}084{,}052$

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[a] Notation and further details are explained in Dixon, Parmenter, Sutton, and Vincent (1982), hereafter DPSV.

[b] G is the set of commodities for which export demands are determined endogenously. The set G, together with the export demand elasticities, is listed in Higgs (1986, table 2.2).

[c] J is the set of industries for which investment is endogenous. The set $\{j \notin J\}$ for which the rate-of-return theory is considered inappropriate, consists of industries 17, 84, 85, 86, 94, 103–108, 111, and 112. For a key to the industry numbers see Higgs (1986, table 5.2).

[d] For the version of ORANI used here:
g (the number of commodities) = 114
h (the number of industries) = 112
M (the number of occupations) = 10
J* (the number of industries for which investment is endogenous) = 99

[e] Notation and further details are explained in Meagher and Parmenter (1985).

describes how the public sector borrowing requirement projections were corrected for flows not captured by the NAGA model. All of these sections are essential for the reproducibility of the results presented in this paper.

Closure and Nominal Rates of Protection

The set of exogenous variables chosen for the ORANI simulations is defined in table 10A.1 in terms of the notation used by Dixon et al. (1982) and Meagher and Parmenter (1985). The input-output and elasticities files as documented in Bruce (1985) were used for this study. The values for the user-specified indexation parameters that were assumed are as in Higgs (1986, table A1.2).

Table 10A.2 shows the nominal rates of protection for Australian manufacturing industries for 1986–87. These are estimates of the extent to which tariff and quota protection raised the domestic prices of imported products. For example, the nominal rate of protection for motor vehicles is 27.10 percent. Thus in 1986–87 an imported car costing $10,000 at the port of Melbourne would cost $12,710 by the time it cleared customs.

Calculation of the Exogenous Shocks When Simulating the Removal of Assistance to Agriculture

In this section we first estimate the producer subsidy equivalents of the assistance given to Australian agriculture. The magnitudes of some "correction" shocks are then calculated to appropriately capture the price effects when the home consumption pricing schemes are removed.

Subsidy equivalent measures. Recall from table 10.1, column [IV], that the IAC has made estimates of the total level of assistance given to agricultural commodities in 1984–85. To simulate the effects of the removal of assistance these estimates must first be converted to the appropriate units given the ORANI model's base period prices and production levels. The IAC (1987) estimates of the 1984–85 levels of assistance and value of output by commodity are given in columns [I] and [II] of table 10A.3. Next, in column [III] of the table, the ratio of the level of assistance, or commodity subsidy equivalent, to the value of output is calculated. This ratio is then multiplied by the value of output in the base period (see column [IV]) to produce estimates of the subsidy equivalents in terms of the base-period prices and with respect to the base-period production levels (see column [V]).

The next step is to convert the commodity subsidy equivalents listed in column [V] of table 10A.3 to industry subsidy equivalents. This was done according to the base-period mix of commodities produced by each of the industries (see Higgs 1986, table 3.1). The resulting matrix of subsidy equivalents by commodity and industry is given in table 10A.4. The industry subsidy equivalents are listed in the final column of the table.

All that remains is to explain how the effects of the removal of the industry subsidy equivalents listed in table 10A.4 were simulated. This was done by making use of the "other costs" input category for each of the agricultural

Table 10A.2 Nominal Rates of Protection for 1986–87

Commodity	Nominal rate of protection (percent)
18 Meat products	0.00
19 Milk products	25.26
20 Fruit and vegetable products	11.20
21 Margarine, oils, and fats nec	6.75
22 Flour mill cereal products	8.39
23 Bread, cakes, biscuits	0.46
24 Confectionery and cocoa	15.75
25 Other food products	10.10
26 Soft drinks, cordials	10.68
27 Beer and malt	30.67
28 Other alcoholic beverages	20.56
29 Tobacco products	7.25
30 Cotton ginning, wool scouring, and top making	2.13
31 Man-made fibers, yarns	30.63
32 Cotton yarns, fabrics	28.57
33 Wool, worsted fabrics	12.19
34 Textile finishing	36.20
35 Textile floor coverings	33.67
36 Other textile products	18.94
37 Knitting mills	63.04
38 Clothing	64.03
39 Footwear	63.53
40 Sawmill products	5.09
41 Veneers and wood boards	18.88
42 Joinery and wood products nec	12.46
43 Furniture and mattresses	22.27
44 Pulp, paper, paperboard	9.27
45 Bags and containers	20.60
46 Paper products nec	20.94
47 Newspapers and books	0.48
48 Commercial printing	18.99
49 Chemical fertilizers	0.97
50 Other basic chemicals	11.76
51 Paints, varnishes	13.43
52 Pharmaceutical goods	6.21
53 Soap and detergents	17.56
54 Cosmetics and toiletries	6.07
55 Other chemical goods	11.19
56 Petrol and coal products	0.12
57 Glass and glass products	6.09
58 Clay products, refractories	3.65
59 Cement	3.26
60 Ready mixed concrete	0.00
61 Concrete products	0.61
62 Nonmetallic mineral products	8.90

Table 10A.2 continued

Commodity	Nominal rate of protection (percent)
63 Basic iron and steel	8.58
64 Nonferrous metals	2.68
65 Structural metal products	12.51
66 Sheet metal products	15.14
67 Other metal products	17.35
68 Motor vehicles and parts	27.10
69 Ships and boats	14.80
70 Railway rolling stock	17.44
71 Aircraft	1.64
72 Scientific equipment	4.68
73 Electronic equipment	19.03
74 Household appliances	22.59
75 Other electrical goods	18.24
76 Agricultural machinery	7.09
77 Construction machinery	17.45
78 Other machinery	12.96
79 Leather products	8.53
80 Rubber products	21.98
81 Plastic products	19.82
82 Signs, writing equipment	12.69
83 Other manufacturing	15.59

Source: Unpublished Industries Assistance Commission estimates.

industries. Note that an exogenous increase in other costs is equivalent to the imposition of a production tax. Column [II] of table 10A.5 contains the inputs of other costs in the base period. It is possible to simulate the effects of the removal of the industry subsidy equivalents by exogenously setting the appropriate percentage change in other costs (see column [III] of table 10A.5).

Correction for home consumption pricing schemes. The above producer subsidy equivalent shocks will result in increased costs to the agricultural producers, which is appropriate if we are simulating the removal of a subsidy. However, the above shocks also tend to result in increased domestic agricultural prices, which is not appropriate if we were attempting to capture the effects of the removal of a home consumption pricing scheme. Recall from table 10.1, column [I], that part of the subsidy to agriculture consists of home consumption pricing schemes. These act to raise the price to domestic consumers of products within such arrangements. Therefore we must

Table 10A.3 Calculation of the Base-period Agricultural Commodity Subsidy Equivalents

Commodity	1984–85 subsidy equivalent[a] ($m 1984–85 prices) [I]	1984–85 value of output[b] ($m 1984–85 prices) [II]	Ratio of subsidy equivalent to value of output {i.e., [I]/[II]} [III]	Typical year value of output[c] ($m 1977–78 prices) [IV]	Typical year subsidy equivalent ($m 1977–78 prices) {i.e., [III] × [IV]} [V]
A1 Wool	92.5	2,288.5	0.0404	1,508.74	60.95
A2 Sheep	17.8	509.5	0.0349	578.67	20.20
A3 Wheat	108.4	2,863.9	0.0382	921.07	35.18
A4 Barley	14.2	574.5	0.0247	176.51	4.36
A5 Other cereal grains	20.9	620.5	0.0337	161.64	5.45
A6 Meat cattle	128.4	2,075.0	0.0619	803.59	49.74
A7 Milk cattle	367.1	1,444.5	0.2541	985.00	250.29
A8 Other farming (sugarcane, fruit, and nuts)	134.3	984.5	0.1364	1,257.67	171.55
A9 Other farming (vegetables, cotton, oil seeds, and tobacco)	48.7	785.1	0.0620	956.61	59.31
A10 Poultry	3.3	743.9	0.0044	400.42	1.76
Total	935.6	12,862.9		7,749.93	658.79

[a] See table 10.1, column [V].
[b] See table 10.1, column [VI].
[c] Source: Higgs (1986).

correct, where possible, for the effects of the above shocks on prices when the subsidy is in the form of a home consumption pricing scheme.

Approximately two-thirds of total assistance to agriculture due to home consumption pricing schemes is for milk (both manufacture and market; see table 10.1, column [I]). Below we explain how to correct for the effects of the above shocks on the price of the commodity milk cattle and pigs. The first step is to estimate the value of the home consumption pricing scheme in terms of base-period prices and with respect to base-period production levels. This is done by taking the ratio of the estimated values in table 10.1 of the home consumption pricing scheme ($342.5 million [1984–85 prices]) to the value of total assistance ($367.1 million [1984–85 prices]) and multiplying it by the subsidy equivalent for the commodity milk cattle and pigs as reported in table 10A.4 ($250.29 million [1977–78 prices]). This results in

Table 10A.4 Subsidy Equivalents to the Agricultural Sector

	Commodity			
Industry	A1 Wool	A2 Sheep	A3 Wheat	A4 Barley
1 Pastoral zone	12.69	2.00	1.64	0.21
2 Wheat-sheep zone	26.17	10.32	32.73	3.67
3 High rainfall zone	22.10	7.88	0.82	0.48
4 Northern beef				
5 Milk cattle and pigs				
6 Other farming (sugarcane, fruit, and nuts)				
7 Other farming (vegetables, cotton, oil seeds, and tobacco)				
8 Poultry				
Total subsidy by commodity[a]	60.95	20.20	35.18	4.36

Note: These figures are estimates of the subsidy equivalents of the various forms of government assistance given to agriculture in terms of millions of 1977–78 Australian dollars.

an estimated value of \$233.52 million (1977–78 prices) (i.e., [\$342.5 million/\$367.1 million] × \$250.29 million).

The second step is to note that in the base period nearly all the sales of the milk component of the commodity milk cattle and pigs were to the milk products industry. This represented a sale of \$609.94 million (1977–78 prices). Thus we would expect a reduction in the costs of milk purchased by the milk products industry of 38.29 percent (i.e., 100 × \$233.52 million/\$609.94 million) if the home consumption pricing scheme were disbanded. However, because of the component of the shock to other costs that accounts for the home consumption pricing scheme, the price of milk is projected to increase by approximately 23.71 percent (i.e., 100 × \$233.52 million/\$985.00 million, where the base-period total sales of milk cattle and pigs is \$985.00 million [1977–78 prices]).

The third and final step is to compute the size of the shock to other costs in the milk products industry that will both cancel out the effect on this industry's costs of the above 23.71 percent increase in the price of milk, plus capture the desired effect of a 38.29 percent fall in the price of milk to this

Commodity						
A5 Other cereal grains	A6 Meat cattle	A7 Milk cattle and pigs	A8 Other farming (sugarcane, fruit, and nuts)	A9 Other farming (vegetables, cotton, oil seeds, and tobacco)	A10 Poultry	Total subsidy by industry
0.14	4.55	0.13	0.06	0.80		22.21
3.84	13.51	15.37	0.41	2.26		108.27
1.48	15.21	5.97	0.90	3.35		58.19
	12.88					12.88
	3.59	228.81				232.40
			170.19			170.19
				52.89		52.89
					1.76	1.76
5.45	49.74	250.29	171.55	59.31	1.76	658.79

[a] Source: derived from IAC (1987); see table 10A.3, column [V].

industry. In other words, what percentage change in other costs is equivalent to a 62 percent (i.e., 23.71 + 38.29) fall in the price of milk sold to the milk products industry? The input of other costs in the base period to the milk products industry is $36.07 million (1977–78 prices). Thus a 62 percent fall in the cost of milk to this industry, which equals $378.16 million (i.e., 0.62 × $609.94 million), is equivalent to a 1,048.41 percent (i.e., 100 × $378.16 million/$36.07 million) decrease in the input of other costs.

The next home consumption pricing scheme we correct for is for wheat. As above, the first step is to estimate the value of the home consumption pricing scheme in terms of base-period prices and with respect to base-period production levels. This is done by taking the ratio of the estimated value in table 10.1 of the home consumption pricing scheme ($43.1 million [1984–85 prices]) to the value of total assistance ($108.4 million [1984–85 prices]) and multiplying it by the subsidy equivalent for wheat reported in table 10A.4 ($35.18 million [1977–78 prices]). This results in an estimated value of $13.99 million (1977–78 prices) (i.e., [$43.1 million/$108.4 million] × $35.18 million).

The second step is to note that, because of the component of the shocks

Table 10A.5 The Exogenous Shocks to "Other Costs" Required to Simulate the Effects of the Removal of the Agricultural Industry Subsidy Equivalents

Industry	Industry subsidy equivalent[a] ($m 1977–78 prices) [I]	"Other costs"[b] ($m 1977–78 prices) [II]	Exogenous shock to "other costs" (percentage change) {i.e. 100 × [I]/[II]} [III]
1 Pastoral zone	22.21	21.62	102.74
2 Wheat-sheep zone	108.27	88.04	122.98
3 High rainfall zone	58.19	33.91	171.60
4 Northern beef	12.88	4.47	288.13
5 Milk cattle and pigs	232.40	29.04	800.34
6 Other farming (sugarcane, fruit, and nuts)	170.29	60.42	281.68
7 Other farming (vegetables, cotton, oil seeds, and tobacco)	52.89	38.79	136.36
8 Poultry	1.76	44.02	4.00

[a] See table 10.A.4.
[b] Source: Bruce (1985).

to other costs that accounts for the domestic pricing scheme for the producers of wheat, the price of wheat is projected to increase by 0.41 percent. This is calculated as follows. The elasticity of the farm gate price of wheat with respect to other costs in the wheat-sheep zone (which produces 93 percent of the total output of wheat in the base period) is 0.0259. Next we note that $13.99 million (1977–78 prices) represents a 15.89 percent increase in other costs in the wheat-sheep zone. Thus a 15.89 percent increase in "other costs" would generate a 0.41 percent (i.e., 15.89 × 0.0259) increase in the price of wheat.

The third step is to note that in the base period domestic sales of wheat to nonwheat producing industries were $127.43 million (1977–78 prices). Thus we would expect a fall in the price of wheat to domestic purchasers of approximately 10.98 percent (i.e., 100 × $13.99 million/$127.43 million) if the home consumption pricing scheme were disbanded. Furthermore, of the $127.43 million (1977–78 prices) domestic sales of wheat, $63.44 million is sold to the flour and cereal products industry. This sale represents approximately 12 percent of total costs to the flour and cereal products industry. The remaining $63.99 million of wheat is largely sold to non-wheat-producing agricultural industries. However these sales represent a relatively small percentage of total costs in these industries.

The final step is to compute the size of the shock to other costs in the flour and cereal products industry (which accounts for approximately 90 percent of domestic nonagricultural sales of wheat in the base period) that will both cancel out the effect on this industry's costs of the above 0.41 percent increase in the price of wheat, plus capture the desired effect of a 10.98 percent fall in the price of wheat if the domestic price arrangements were disbanded. In other words, what percentage change in other costs is equivalent to an 11.39 percent (i.e., 0.41 + 10.98) fall in the price of wheat sold to the flour and cereal products industry? The input of other costs in the base period to the flour and cereal products industry is $18.42 million (1977–78 prices). Thus an 11.39 percent fall in the price of wheat to this industry, which equals $7.23 million (i.e., 0.1139 × $63.44 million), is equivalent to a 39.25 percent (i.e., 100 × $7.23 million/$18.42 million) decrease in the input of other costs.

The Public Sector Borrowing Requirement Projections

In this note we explain how the PSBR projections reported in tables 10.2 and 10.3 were corrected for flows not captured in the NAGA model. Recall that the PSBR is equal to government outlays less government income. It is assumed that the flows not captured by NAGA only affect government outlays. Before any corrections were made, the NAGA model projected a $742 million (1984–85 prices) decline in government outlays if assistance to agriculture were removed. This projection failed to account for the direct savings to the government from the subsidies being removed. These direct savings can be estimated from table 10.1.

Total assistance to agriculture is equal to $935.6 million (1984–85 prices); however, $514.6 million is in the form of domestic price arrangements. Thus roughly $421.0 million (i.e., $935.6 million – $514.6 million) of assistance is direct government outlays. This amount needs to be subtracted from the projected decrease in government outlays of $742 million to give a corrected projection of a decline of $1,163 million. In other words, a reduction of 1.34 percent (i.e., 100 × $1,163 million/$86,535 million) is the corrected projection for government outlays.

To calculate the corrected PSBR projection we subtract the projected decline of $919 million (1984–85 prices) in government income from the above reduction of $1,163 million in government outlays. This produces a corrected PSBR projection of a fall of $244 million. In other words, a fall of

1.61 percent (i.e., 100 × \$244 million/\$15,118 million) is the corrected projection for the PSBR.

Notes

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1. This was initially due to efforts by the United States, and then due to representations made by the Europeans at the Kennedy Round; see Dam (1970) and Rausser and Wright (1987).

2. See, for example, Ballenger, Dunmore, and Lederer (1987).

3. See Stoeckel and Cuthbertson (1987).

4. Note that Parmenter (1986) found that the National Farmers' Federation (which based part of its submission on work by Clements and Sjaastad 1985) had actually overestimated the cost penalty of manufacturing protection. However, the revised estimate is still easily the largest item among the cost penalties suffered by farmers owing to government intervention in the economy.

5. Other studies which have used the ORANI model to look at the implications of protection and which report results for the agricultural sector include Dixon, Powell, and Parmenter (1979), Crowley and Martin (1982), Dixon, Parmenter, and Powell (1982), Quiggin and Stoeckel (1982), Dixon et al. (1983), and Industries Assistance Commission (1985).

6. See Vincent, Dixon, and Powell (1980).

7. Australian agricultural production and profitability exhibits marked year-to-year variability, largely as a result of fluctuations in both climatic conditions and world prices. It is important therefore that the data base of a model designed to yield policy insights, as opposed to forecasts, captures typical year features and not transient influences. For more details see Adams (1984), Higgs (1985), and Adams and Higgs (1986). Note that the nonagricultural part of the model is calibrated from the 1977–78 input-output table; see Australian Bureau of Statistics (1983) and Bruce (1985).

8. See also Pearson (1988) and Agrawal and Meagher (1987). Note that the process of solving the linear equations uses the Harwell sparse matrix code (see Duff 1977).

9. See Parmenter, Sams, and Vincent (1981) for a study of the allocative effects of home consumption pricing schemes using the ORANI model.

10. A complete list of the variables selected as exogenous is given in table 10A.1.

11. That is, the percentage change in the pretax wage rate is exogenous and set equal to the percentage change in the CPI.

12. For the technical details see appendix A.

13. The nominal rates are listed in table 10A.2. See also Parmenter (1977) and Lawson (1984) for a description of how the tariff rates are calculated in ORANI, and

Chai and Dixon (1985) for the estimation of the average rates of protection.

14. This result is at variance with ORANI results in which the closure holds real absorption constant (e.g., Dixon et al. 1982, chapter 7). In the simulations reported here, the expansions in consumption and investment lead to the increase in imports outstripping the increase in exports.

15. Note that this is only a rough estimate of the effect of the tariff cut on government income. This is due to the tension between the 1986–87 tariff rates which are used to shock relative prices and the implicit tariff rates in the NAGA module. However, as the tariff equivalents of quotas are relatively insignificant in 1986–87 due to the depreciation of the Australian dollar, the tension is less than it would otherwise have been.

16. See Higgs (1986, appendix A.2) for the derivations of equations (2) and (3).

17. Note that $\lambda_6 = 1.65$.

18. Note that $\lambda_7 = 3.09$ and the subsidy to the other farming (vegetables, cotton, oil seeds, and tobacco) industry is equal to 6.20 percent of its total costs.

19. The meat products industry is modeled as using unprocessed meat inputs in fixed proportions. Note that $\lambda_8 = 2.97$.

References

Adams, P. D. 1984. The typical year data base for the agricultural sector of ORANI 78. IMPACT Preliminary Working Paper no. OP–45. Mimeo.

Adams, P. D., and P. J. Higgs. 1986. Calibration of computable general equilibrium models from synthetic benchmark equilibrium data sets. IMPACT Preliminary Working Paper no. OP–57. Mimeo.

Agrawal, N., and G. A. Meagher. 1987. How to compute solutions with the NAGA add-on to the ORANI model. University of Melbourne. Mimeo.

Australian Bureau of Statistics. 1983. *Australian national accounts, input-output tables 1977–78.* Catalogue no. 5209.0. Canberra: Australian Government Publishing Service.

Ballenger, N., J. Dunmore, and T. Lederer. 1987. *Trade liberalization in world farm markets.* U.S. Department of Agriculture, Agriculture Information Bulletin no. 516. Washington, D.C.

Brigden, J. B., B. D. Copeland, E. C. Dyason, L. F. Giblin, and C. H. Wickens. 1929. *The Australian tariff: An economic enquiry.* Melbourne: Melbourne Univ. Press.

Bruce, I. 1985. The ORANI 78 input-output and parameter files for 1977–78. IMPACT Preliminary Working Paper no. OP–51. Mimeo.

Carmichael, W. B. 1986. National interest and international trade negotiations. *The World Economy* 9:341–57.

Chai, S. S., and P. B. Dixon. 1985. Protection in Australia: A description. IAESR Working Paper no. 8/1985. Institute of Applied Economic and Social Research, Univ. of Melbourne. Mimeo.

Clements, K. W., and L. A. Sjaastad. 1985. *How protection taxes exporters.* Thames

Essay no. 39. London: Trade Policy Research Centre.

Cobb, M. 1983. *The great tariff debate, A comprehensive review.* Sydney: Livestock and Grain Producers' Association of New South Wales (Burdekin Trust Fund).

Cooper, R. J. 1983. A tariff experiment on the interfaced ORANI-MACRO system. IMPACT Preliminary Working Paper no. IP–17. Mimeo.

Crowley, P., and Martin, G. 1982. Manufacturing industry assistance and the rural sector. *Quarterly Review of the Rural Economy* 4:288–94.

Dam, K. W. 1970. *The GATT: Law and economic organization.* Chicago: Univ. of Chicago Press.

Dixon, P. B. 1985. Agriculture in the Australian economy, Unlocking farm potential. In *Proceedings—Systems for profit towards integrated crop-stock farming,* 1-13. Perth: Farm Management Foundation of Australia.

Dixon, P. B., B. R. Parmenter, and A. A. Powell. 1982. Farm incomes and the real exchange rate in Australia: Evidence from the ORANI model. IMPACT General Paper no. G–41. Mimeo.

Dixon, P. B., B. R. Parmenter, A. A. Powell, and D. P. Vincent. 1983. The agricultural sector of ORANI 78: Theory, data and application. In *Modeling Growing Economics in Equilibrium and Disequilibrium,* ed. A. C. Kelley, W. C. Sanderson, and J. G. Williamson. Durham, N.C.: Duke Univ. Press.

Dixon, P. B., B. R. Parmenter, J. Sutton, and D. Vincent. 1982. *ORANI: A multisectoral model of the Australian economy.* Amsterdam: North-Holland Publishing Co.

Dixon, P. B., A. A. Powell, and B. R. Parmenter. 1979. *Structural adaptation in an ailing macroeconomy.* Melbourne: Melbourne Univ. Press.

Duff, I. S. 1977. *MA28—A Set of Fortran Subroutines for Sparse Unsymmetric Systems of Linear Equations.* Atomic Energy Research Establishment Harwell, Report R.8730. London: Her Majesty's Stationery Office.

Edwards, G. W., and A. S. Watson. 1978. Agricultural policy. In *Surveys of Australian economics,* ed. F. H. Greun. Sydney: Allen and Unwin.

Higgs, P. J. 1985. Implementation of Adams's typical year for the agricultural sector in the ORANI 1977–78 data base. IMPACT Preliminary Working Paper no. OP–49. Mimeo.

Higgs, P. J. 1986. *Adaptation and survival in Australian agriculture.* Melbourne: Oxford Univ. Press.

Industries Assistance Commission. 1983. *Assistance to Australian agriculture.* Canberra: Australian Government Publishing Service.

———. 1985. *Fertilizers.* Canberra: Australian Government Publishing Service.

———. 1987. *Assistance to agricultural and manufacturing industries.* Canberra: Australian Government Publishing Service.

Johansen, L. 1960. *A multi-sectoral study of economic growth.* Amsterdam: North-Holland Publishing Co.

Lawson, T. 1984. ORANI industry tariff rates. Industries Assistance Commission Research Memorandum no. OA–235. Mimeo.

Lloyd, P. J. 1978. Protection policy. In *Surveys of Australian economics,* ed. F. H.

Gruen. Sydney: Allen and Unwin.

Meagher, G. A. 1983. Fiscal policy and Australian industry: The effects of a change in the mix of direct and indirect taxation. Department of Economics, La Trobe University, Discussion Paper no. 7/83. Melbourne.

Meagher, G. A. 1984. ORANI-SRF01: *A model for computing the effects of changes in fiscal policy on the short-run forecasts of the IAESR*. IAESR Working Paper no. 5/1985. Institute of Applied Economic and Social Research, University of Melbourne.

Meagher, G. A., and B. R. Parmenter. 1985. *Some short-run effects of shifts from direct to indirect taxation*. IAESR Working Paper no. 10/1985. Institute of Applied Economic and Social Research, University of Melbourne.

National Farmers' Federation. 1985. Farm costs. Submission to the Prime Minister, March. Typescript.

Parmenter, B. R. 1977. *The problem of calculating tariff rates for input-output industries*. Industries Assistance Commission Research Memorandum no. OA-14.

———. 1986. *What does manufacturing protection cost farmers? A review of some recent Australian contributions*. IAESR Working Paper no. 7/1985. Institute of Applied Economic and Social Research, University of Melbourne.

Parmenter, B. R., D. Sams, and D. P. Vincent. 1981. Who pays for home consumption pricing schemes? *Economic Record* 57:168–79.

Pearson, K. R. 1988. Automating the computation of solutions of large economic models. *Economic modeling* 5 (October):385–95. Also released as IMPACT Preliminary Working Paper No. IP–27, 1986. Mimeo.

Pearson, K. R., and G. Codsi. 1988. Developing and implementing large economic models using GEMPACK, A general purpose software suite. Paper presented at the Second International Conference on Economic Modelling, March 28–30, London.

Quiggin, J. D., and A. Stoeckel. 1982. Protection, income distribution and the rural sector. *Economic Papers* 1:57–71.

Rausser, G. C., and B. D. Wright. 1987. *Alternative strategies for trade policy reform*. Department of Agricultural and Resource Economics, Division of Agriculture and Natural Resources, Univ. of California, Berkeley, Working Paper no. 441.

Stoeckel, A., and S. Cuthbertson. 1987. *The game plan: Successful strategies for Australian trade*. Canberra: Centre for International Economics.

Vincent, D. P., P. B. Dixon, and A. A. Powell. 1980. *The estimation of supply response in Australian agriculture: The CRESH/CRETH production system*. International Economic Review 21:221–42.

11. Costs of Agricultural Trade Wars

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Summary

In this chapter we present an alternative approach to the analysis of the cost of agricultural protection—one which is suggested by the notions of retaliation and trade wars. This procedure may be readily applied to a number of strategic policy issues that are of interest in agricultural trade policy evaluation. Specifically, existing general equilibrium trade models may be used to generate the payoffs for these games. We illustrate these procedures using a global numerical trade model developed by Whalley (1985, 1986). We also show the usefulness of the noncooperative trade war approach as a measure of bargaining strength. The quality of the conclusions from cooperative games depends intimately on the quality of the analysis of the noncooperative game. We also show that the global costs of an escalation of an agricultural trade war are very high.

The general point that we illustrate is that the concept of self-interest must be defined and evaluated in a strategic context. The only exceptions are "degenerate" cases (strategically speaking) in which one or more countries have dominant strategies available.

Our specific quantitative results demonstrate the extreme importance of understanding the politico-economic process that causes governments to consider one policy as better than another. When we substitute domestic agricultural production levels for welfare in the payoffs of our trade war games, we are implicitly making a statement about this process. We recognize that

our approach is crude and ad hoc, but so is our perception of the trade policy formation process. Nonetheless, this stylistic characterization of alternative policy objectives starkly shows that governments can be led to take extremely costly policy actions while seeming to act in the "best interests" of one sectional group of society. This point is not new, but deserves emphasis and further study.

One major implication of our results is that anything that restrains the (natural and healthy) strategic lust of the EC and the United States to engage in trade wars is likely to prevent serious disruption to global agricultural markets.

This conclusion reinforces a view of the GATT that is somewhat more charitable than popular economic wisdom. Whalley (1985, 255) suggests that

> much of the policy activity within forums such as the GATT can be seen as "accommodation-preserving" activity. Existing cooperative arrangements reduce protection below the levels that would prevail in their absence. The changes that take place from one negotiating round to another may be relatively small, but at least they preserve what cooperation has already been obtained. Viewed from this stance, the GATT and other international arrangements as "process" are significant.

Our results reinforce this view of the importance of the GATT.

Introduction

It is apparent that an agricultural trade war is currently in progress between the United States and the EC. We examine the game-theoretic aspects of this trade war and attempt to evaluate its welfare costs. An important contribution of our approach is to identify the strategic nature of the "self-interest" that leads a nation to undertake such retaliatory trade policy actions. We argue that it is fruitless to rely on the self-interest of large nations to stop such trade wars if one does not allow for the threat of retaliation by other nations. This perspective has certain important implications for possible negotiated settlements with regard to international agricultural trade policy.

In this chapter's second section we explain and illustrate the game-theoretic notions that we use throughout. The central concept is that of a Nash Equilibrium, which is simply a set of policies for the United States and the EC such that neither country would want to change their policies unilaterally. In other words, each country is selecting its most preferred policies given the policy choices of the other nation. The central idea of this paper, that "self-interest" cannot and should not be defined independently of the possibility of strategic retaliation by other nations, is explained in this section.

In the third section we apply the concept of a Nash Equilibrium to evaluate the outcome of a strategic trade war in agriculture between the United States and the EC.[1] We use a global numerical general equilibrium model developed by Whalley (1985, 1986) to evaluate the payoffs to each nation from alternative policy choices. Details of our computational procedures, which are of independent but technical interest for present purposes, are presented in Harrison and Rutström (1988). The range of policy choices that we consider here allows us to draw some conclusions about the likely outcomes of a full-blown trade war.

We consider two types of trade war. The first assumes that governments care only about national welfare and the second assumes that they care only about domestic agricultural production. We interpret the first of these as an efficiency trade war, in the sense that the effect on efficiency is the direct object of concern by the two governments. The second trade war can be interpreted as a nonefficiency trade war, in that governments do not directly concern themselves with the welfare effects of their agricultural trade policies. This situation could be viewed as the result of a behind-the-scenes lobbying game in which agricultural interests have managed to convince government that the objective of agricultural trade policy should be to protect domestic agricultural production levels.

In the fourth section we consider the implications of our basic trade war results for the outcome of a negotiated agreement between the United States and the EC. This agreement would be the outcome of cooperative negotiations, such as are occurring on a multilateral basis under the auspices of the GATT, rather than the outcome of a noncooperative trade war. Nonetheless, the outcome of the trade war can have a dramatic impact on the former negotiated agreement by determining the relative threats that each nation can credibly bring to any bargaining table.

After this we evaluate the prospects and consequences of an escalation of agricultural trade wars. We consider an expansion of the bilateral war between the EC and United States to include Japan, as well as an expansion to nonagricultural trade.

We emphasize at the outset that the game-theoretic concepts and computations that we undertake are extremely stylized, in the sense that they should be qualified before our results are applied to policymaking. This is more than the natural reticence of scholars to take responsibility for the use or abuse of their research: we identify throughout a number of dimensions in which our specific results might properly be questioned. In the chapter's sixth section we explicitly consider several alternative formulations of the strategic agricultural trade issue. However, the main contribution of our results is to propose and illustrate a conceptual and quantitative approach to strategic trade issues which can be readily extended to deal with such qualifications.

Strategic Self-Interest

Imagine that some policy action that would improve the well-being of all of its citizens was available to the United States. Forget, for the moment, the unbridled self-interest of sectional lobby groups, or the myopia of politicians. Let us assume that transparency reigns such that the political actors can see what is best and have the political willpower to act accordingly if they want to. Should the United States pursue this policy action? Before answering this question we need to know one more piece of information. Will this action lead to any retaliatory policy action from any other nation that could "hurt" the citizens of the United States? Assume that the citizens of the EC would be hurt by this action of the United States if it were carried out. In other words, the citizens of the EC are assumed to be worse off if the United States implements this policy than if it does not. The next question, then, is whether or not the EC has any policy of its own that can be used to retaliate against the United States (or to threaten to retaliate).

Assume that the EC does have such a policy. Will they use it? That depends on whether or not the EC is better off using it. And if they use it, it will influence and possibly change the initial U.S. policy decision. Thus the self-interest of each nation is linked necessarily to the actions that it expects other nations to take. It is simply impossible to define the self-interest of one nation independently of the self-interest of other nations, unless the actions of one nation have no impact at all on the well-being of other nations, or if the other nations have no retaliatory threat that would lead the first nation to choose one action over another.

Game theory provides a framework that enables us to untangle this apparent infinite regress of semantics. Specifically, the Nash Equilibrium (NE) concept is a way of predicting what the outcome will be if each and every nation pursues its own self-interest while expecting the other nations to do the same. The NE concept does not describe a process of retaliation, but the outcome of such a process.

To illustrate the importance of accounting for strategic retaliation in trade policy, consider the two simple games with payoff matrices shown in table 11.1. In each case we have taken the payoffs from policy simulations generated by the global general equilibrium (GE) model of Whalley (1985, 1986). Two agents are considered: the United States and the EC. Each agent has just two pure strategies in each game. In game 1 each agent can do nothing (N) or can abolish (A) agricultural trade barriers. In game 2 the EC can increase agricultural protection by 100 percent or 200 percent and the United States can increase protection by 150 or 200 percent. We shall consider much more detailed policy options later, but the essential ideas can be understood with just two strategies.

In each game in table 11.1 the abolition strategy refers to all tariff and nontariff barriers, abolished on a nondiscriminatory basis. In other words, we are allowing each nation to remove all agricultural protection against imports from all other nations (the alternative would be to have them remove protection only against imports coming from particular nations). The payoffs shown in the two games are the annual welfare impact, as measured by the Equivalent Variation in income in billions of 1977 U.S. dollars.

Consider game 1 first. The NE of this game is extremely simple to compute; in fact, it can be read directly from the payoff matrix. If the EC does nothing, the United States has two policy choices available to it with payoffs of 0 and -3.64, respectively. Clearly it is in the self-interest of the United States to choose the first policy, which involves it doing nothing. Note that this policy choice is conditional on the assumed behavior of the EC.

If the EC were to abolish protection, the United States again has two policy choices available to it. This time, however, the payoffs to the United States from these two actions are 1.53 and -2.15, respectively. Although the values of the payoffs are quantitatively different to the United States (depending on what the EC does), the predicted outcome for the United States is the same in each case: to do nothing. Thus the United States can be counted on by the EC to follow the policy of doing nothing. This is called a dominant strategy for the United States. It is always in the best interest of a country to follow a dominant strategy, irrespective of the actions of the other country. (In this case we have a strongly dominant strategy, since the payoffs to the United States for the alternative action are strictly lower; weakly

Table 11.1 Two Simple Agricultural Trade Games

Game 1

	EC payoffs		U.S. payoffs	
	U.S.^{N}	U.S.^{A}	U.S.^{N}	U.S.^{A}
EC^{N}	0.0	0.96	0.0	−3.64
EC^{A}	−6.97	−6.03	1.53	−2.15

Game 2

	EC payoffs		U.S. payoffs	
	U.S.^{150}	U.S.^{200}	U.S.^{150}	U.S.^{200}
EC^{100}	1.16	1.06	0.23	0.21
EC^{200}	1.33	1.22	−0.37	−0.36

Note: Payoffs shown are welfare changes compared to benchmark.

dominant strategies are defined in an obvious manner.)

Now consider the self-interest of the EC. If the United States were to do nothing, it has two policy choices open, leading to payoffs of 0 and −6.97, respectively. In this case it would choose to do nothing. If the United States were to abolish agricultural protection, the EC's two policy choices provide it with payoffs of 0.96 and −6.03, respectively. The EC would choose to do nothing in this case as well. Thus the EC also has a (strongly) dominant strategy to do nothing in this particular game. Even if the EC did not have this dominant strategy, we could have restricted our analysis to the first set of choices for the EC, since the EC could be safe in assuming that the United States would do nothing (irrespective of what it, the EC, decided to do).

In game 1, therefore, the NE is simply for each country to do nothing. Because each country had a dominant strategy available to it, the self-interest of each country could be defined independently of the conjectured retaliation of the other nation.

The NE outcome in game 2 is not quite as simple, however. The best strategy for the United States depends on the strategy chosen by the EC. If the EC increases protection by 100 percent, the United States would prefer to increase protection by 150 percent; conversely, if the EC increases protection by 200 percent, the United States would prefer to increase its protection by 200 percent. Which policy is in the self-interest of the United States to follow? Fortunately, the EC will choose to increase protection levels by 200 percent irrespective of the United States' choice here, so it is in the self-interest of the United States to do likewise and increase protection by 200 percent (this is the NE of game 2). Our point, however, is that one could not define the self-interest of the United States in game 2 without making some conjecture about the behavior of the EC.

We shall see, below, that the payoff structure for trade policy games is not always so simple as in games 1 and 2. If a country does not have a dominant strategy available to it, it will need to form some conjecture as to the likely strategy choice of the other country. We do not explain or analyze this process of conjecture and counterconjecture. Instead we focus on a set of strategies that are consistent with correct conjectures—a NE.

We would like to stress four obvious but important qualifications to this result and our approach, even at this simple illustrative level. First, the welfare or production impacts shown may not be robust to variations in the parameters (or underlying structure) of the GE model. Even at a casual level we can see that the equilibrium point of game 2 might alter with relatively small changes in the production impacts for either the United States or the EC. These small changes in welfare may, in turn, be generated by small perturbations of key elasticities in the underlying model (e.g., see Harrison et al. 1987). Thus the robustness of the GE results are essential to the robustness of the game.

The second qualification is that we are considering extreme pure strategies in these two examples. It is quite possible that there exist intermediate pure strategies, involving something less than the total abolition of agricultural trade barriers, such that some U.S.-EC liberalization would occur in a noncooperative equilibrium. The operationalization of a response to this qualification involves taking finer grids of pure strategies. We are able to do this with our approach, subject to familiar constraints on computational expense. We illustrate this point in the next section.

A third, and related, qualification is the proper interpretation of mixed strategies in games with finite pure strategies. In game theory, a mixed strategy involves an agent employing two or more pure strategies with a specific probability of playing any one of them. An explicit assumption in such games is that only one of the strategies will eventually be played by each player. The expected payoff, for the purposes of premove analysis, is therefore linear in the pure strategy payoffs, with the mixed strategy probabilities providing the linear weights on the discrete pure strategy payoffs. Thus a 50-50 mix of a zero tariff and a 60 percent tariff will imply an expected payoff exactly equal to the simple average of the two pure strategy payoffs. However, this should not be confused with the payoff that a GE model implies for a 30 percent tariff. The implicit function linking strategy values and payoffs is unlikely to be linear, save as an approximation that we will not accept in general (and especially for strategic alternatives that involve major policy changes).

The final qualification is that our analysis of game 1 implies only the absence of a welfare-improving noncooperative outcome. Such a result may therefore point the way towards the necessity of cooperative solutions to the U.S.-EC agricultural trade policy problem. More importantly, it provides one starting point, the disagreement outcome, in a subsequent analysis of the cooperative game in the sense of Nash (1950, 1953); see "Agricultural trade agreements," below, for an illustration.

The point of the above examples is to introduce our general approach. Typically, the strategic equilibrium of the trade games implicit in applied general equilibrium models will not be so easily identified. Not only shall we want to consider a wider range of pure strategies, but we might also need to consider equilibria in mixed strategies. Thus the need for a computational approach, which we now turn to.

Nash (1951) employed nonconstructive fixed-point methods to prove the existence of (Nash) equilibrium points for a wide class of n-person noncooperative games with finite strategies. Harrison and Rutström (1988) review his approach and present a computational procedure to implement it following Hansen (1974). This procedure is guaranteed to find at least one equilibrium point, possibly in mixed strategies. It can also locate multiple equilibrium points if they exist, although it cannot guarantee to locate more than one point or to locate all points.

In some finite games it is possible to locate an equilibrium in pure strategies, essentially by inspection of all pure strategy combinations (e.g., see Markusen and Wigle 1987, or our analysis of games 1 and 2). It is a straightforward computational matter to identify the complete set of pure strategy equilibria by exhaustive inspection of all combinations. However, pure strategy equilibria cannot be guaranteed to exist in all finite games: hence the general need for more powerful computational procedures. We view these procedures as complementary to the identification of possible pure strategy equilibria by means of exhaustive inspection.

Agricultural Trade Wars

We consider a bilateral EC-U.S. trade war with respect to agricultural protection using the computable GE trade model of Whalley (1985, 1986) to evaluate the payoffs. The actors in this trade war are the EC and the United States; all other nations are assumed to be strategically passive in the experiments. We believe that it is not plausible to expect that any Other Developed Countries (ODCs), NICs, or LDCs would be able to cooperate as individual blocs in order to retaliate. This point of view is based on casual observation of the increasingly pluralistic nature of GATT negotiations, especially the current round of multilateral talks.

We do not consider retaliation by Japan, on the grounds that she does not appear to be an active player in the current agricultural trade war and does not have great market power compared to the EC and the United States.[2] On the other hand, her levels of protection on agricultural imports are extremely high, which might indicate that it would be worth expanding our trade war to include Japan in future work.

The pure strategies investigated for each nation consist of percentage increases in their existing protection structure for agricultural trade. We include tariffs and nontariff barriers (NTBs). The latter are clearly much more important than tariffs for most industrial nations, and are incorporated in the GE model in ad valorem equivalent form. In the benchmark the EC imposes tariff (and NTB) protection on agricultural imports at about a 5 percent (36 percent) rate, with virtually no differentiation by import source. The United States imposes tariff (and NTB) protection at rates of 5 percent (19 percent), 2 percent (44 percent), 5 percent (31 percent), 4 percent (31 percent), and 2.5 percent (31 percent) on imports from the EC, Japan, Canada, ODC, and the "OPEC, NIC, and LDC" group, respectively. The differences in rates by source arise primarily because the protection considered here is a trade-weighted aggregate of all agricultural commodities. It is clear, then, that all of the action here is in terms of NTBs, with post-Kennedy Round tariff levels being very low for the EC and the United States.

Each nation increases its level of agricultural protection in a nondiscriminatory fashion. That is, the EC increases protection against imports from all sources (rather than just against imports from the United States and Japan, for example). The effects of a geographically discriminatory trade war might be quite different.

We assume that the payoffs to each nation are the changes in welfare of the consumers of the country. This is measured in terms of the Equivalent Variation (EV) in benchmark dollar terms (the base year is 1977 in this model, and the benchmark monetary measure is the U.S. dollar). This is a standard measure of changes in welfare for models where consumers are homogeneous within each country.

Table 11.2 shows the stages of the trade war simulations conducted along the lines described above: nondiscriminatory, agricultural protection only, and with welfare as the payoff. Each stage represents a choice of five or seven pure strategies by each nation. This restriction to five or seven strategies in each stage is due to the computational expense of solving the GE model used here to evaluate welfare. With two nations each choosing seven pure strategies, we required forty-nine solutions to the underlying GE model corresponding to the possible configurations of policy settings.

Once the payoffs for each stage have been computed, we solve each stage as a complete game. We compute all pure strategy NE, and then compute as many mixed strategy NE as possible. The strategies with asterisks in table 11.2 are those employed by each nation in the NE for that game. As only one NE was found for each stage, the interpretation of more than one strategy having an asterisk is that the nation is pursuing a mixed strategy in the NE. We report the payoffs at the NE in brackets for each stage.

In stage 1, we see that the EC and the United States choose to increase protection by 20 percent each, which is the maximum allowed increase in this stage. Note that neither nation has any incentive here to adopt the free trade outcome in which both decrease protection by 100 percent. The EC gains U.S. $0.42 billion and the United States gains U.S. $0.09 billion. This outcome can be understood in the following context. Since the EC and United States are both large trading countries, they can depress the price of the goods they buy by imposing protection. This phenomenon is referred to as a terms of trade gain.

When we find a NE outcome that employs an extreme pure strategy at a certain stage, we shift the pure strategy space to include that extreme pure strategy setting as an interior point in the strategy set. (An extreme pure strategy is here interpreted as a strategy on the boundary of the strategy set.) We then recompute forty-nine (or twenty-five) solutions with the new strategy settings, solve for the NE, and so on. Thus in stage 2 we explore higher levels of protection for the EC and the United States, since they chose extreme values in the NE of stage 1. This process of shifting the strategy space continued in this trade war until stage 2, in which the NE was

Table 11.2 Stages of the Agricultural Trade War: Payoffs in National Welfare

Players: EC and United States
Strategies: Percentage increases in existing protection on imports of agricultural goods; nondiscriminatory.
Payoffs: Change in national welfare, as measured by EV (in 1977 U.S. $ billion); NE payoffs in each stage shown in brackets.

Stage	EC	U.S.
1	20*	20*
	0	0
	−20	−20
	−40	−40
	−60	−60
	−80	−80
	−100	−100
	(0.42)	(0.09)
2	600	600
	500	500
	400	400
	300	300
	200*	200
	100	100*
	0	0
	(1.46)	(−0.30)
3	200	200
	150*	150*
	100	100
	50	50
	0	0
	(1.45)	(−0.04)
4	200	200
	175*	175*
	150	150
	125	125
	100	100
	(1.24)	(−0.22)

*The strategies with asterisks are those employed by each entity in the NE for that game.

in the interior of the strategy space for both agents. We then refined the grid of pure strategies somewhat to provide a more accurate assessment of the NE. The outcome in stage 4 that we report as a trade war is the end point of this process.[3]

We see from table 11.2 that in the final NE the EC would increase protection 175 percent for a gain in welfare of U.S. $1.24 billion, and the United

States would increase protection by 175 percent for a welfare loss of U.S. $0.22 billion. These results again illustrate the basic point that Johnson (1954) was making: that retaliatory trade wars are not always losing propositions for all nations. In this case, we find that the EC wins and the United States loses, relative to the status quo.

Table 11.3 reports some of the global effects of this agricultural trade war outcome. GNP falls slightly in all countries other than the EC and the United States, as does welfare. These changes are qualitatively consistent with the changes in the (commodity) terms of trade for each country. By improving their terms of trade sufficiently, the EC is able to gain on balance from the agricultural trade war and the United States is able to cut its losses. It is interesting to note that the NICs lose proportionately the most from this trade war, with a welfare loss of almost 1 percent of GNP, and LDCs run a close second. The world welfare loss from this trade war is approximately U.S. $13 billion.

Given that the EC and the United States raise their protection so much, and that the ODC, LDC, and NIC blocs lose so heavily, our assumption that other parties will not retaliate may appear to be inappropriate. However, the fact that these blocs lose from the trade war does *not* imply that they would do any better by retaliating. Whether or not they would do better is an open empirical matter for future research.

Table 11.4 shows the impact of the trade war on the global production structure and factor allocation. Agricultural production falls in every country, with Canada and NICs bearing the largest percentage losses. The sectors that gain the most in production from the trade war are the nontraded sectors of the two protagonists: they provide the only immediately safe haven for the factors released by agriculture in these countries. There are several slight expansions of nonagricultural sectors in countries other than the United States and EC.

The escalation of agricultural protection causes output of the agriculture sector as a whole to decline when protection is increased on all agricultural imports. While this outcome may seem startling, it results from both the particular experiment we analyze and the high level of aggregation in the model. Agricultural imports are important inputs to production in the highly aggregated agriculture sector, since it includes both primary agriculture and food processing. Escalation of protection can have the effect of contracting the production of the food-processing sectors whose input prices have increased. This decrease in output may exceed the increase in output of the

Table 11.3 Effects of Trade War on GNP and Welfare

Region	Base GNP	Change in GNP	EV	EV as % of GNP
EC	1683	0.8	1.24	0.07
U.S.	2031	0.2	−0.22	−0.01
Japan	773	−0.3	−0.27	−0.04
Canada	198	−0.6	−0.69	−0.35
ODC	1900	−2.4	−3.01	−0.16
OPEC	300	−0.4	−0.47	−0.16
NIC	493	−2.6	−4.66	−0.95
LDC	819	−2.5	−4.95	−0.60
World			−13.0	

import-competing parts of our highly aggregated agriculture sector.

Table 11.5 shows the effect of the trade war on the structure of global agricultural trade. These results are excerpts from a complete sectoral breakdown of the structure of trade listed in tables 11A.1 and 11A.2 in appendix A. The devastating effect that this trade war has on agricultural trade is evident from the negative entries in table 11.4. EC exports to the United States, ODC, OPEC, and LDCs decline heavily by U.S. $600 million, U.S. $280 million, U.S. $120 million, and U.S. $110 million, respectively, for a total decline of U.S. $1,170 million. U.S. exports to the EEC decline heavily by U.S. $1,410 million, and total exports decline by U.S. $1,790 million. Most of the effects on agricultural exports of other countries concern their trade with the United States and the EC.

It is apparent from these results that other nations would have some incentive to retaliate against the two antagonists. Whether or not they could improve their lot by so retaliating is an open empirical question. We do not believe that it is politically feasible for these nations to coordinate their actions in any strategically effective manner, but that is also a matter open for conjecture. These results also point to the basic bargaining strength that these terms of trade effects provide for the EC and the United States in global trade negotiations.

Agricultural Trade Agreements

The EC and the United States are two of the many actors in a multilateral trade agreement that is currently being launched under the auspices of the GATT: the Uruguay Round. Agriculture is one of the most important topics

Table 11.4 Effects of Trade War on Global Production Structure

		Production			Labor		Capital	
Region	Sector	Base	Change	Percentage change	Change	Percentage change	Change	Percentage change
EC	Agriculture	396	−7.7	−1.9	−1.30	−1.9	−0.96	−2.0
	Mining	18	−0.1	−0.6	0.00	0.0	0.00	0.0
	Energy	107	−0.3	−0.3	−0.07	−0.3	−0.05	−0.3
	Nonmech. man.	554	−1.7	−0.3	−0.41	−0.3	−0.20	−0.4
	Mech. man.	317	−1.3	−0.4	−0.44	−0.4	−0.09	−0.5
	Nontraded	1558	6.1	0.4	2.22	0.5	1.41	0.3
U.S.	Agriculture	474	−3.8	−0.8	−0.49	−0.9	−0.39	−0.7
	Mining	54	−0.4	−0.7	−0.10	−0.6	−0.07	−0.5
	Energy	18	−0.1	−0.6	−0.01	−0.2	−0.01	−0.5
	Nonmech. man.	832	0.1	0.0	−0.06	−0.0	0.05	0.1
	Mech. man.	464	−0.4	−0.1	−0.15	−0.1	0.02	0.1
	Nontraded	2150	3.7	0.2	0.83	0.1	0.79	0.5
Japan	Agriculture	180	−0.3	−0.2	−0.08	−0.2	−0.02	−0.1
	Mining	4	0.0	0.0	−0.01	−0.8	−0.01	−0.7
	Energy	7	0.0	0.0	0.00	0.0	0.00	0.0
	Nonmech. man.	426	−0.1	−0.0	−0.02	−0.0	−0.02	−0.0
	Mech. man.	219	0.4	0.2	0.08	0.2	0.03	0.2
	Nontraded	730	0.0	0.0	0.02	0.0	0.01	0.0
Canada	Agriculture	22	−0.8	−3.6	−0.18	−3.2	−0.07	−3.1
	Mining	16	0.2	1.3	0.06	1.2	0.05	1.2
	Energy	8	0.2	2.6	0.03	1.4	0.03	1.6
	Nonmech. man.	132	0.1	0.1	0.03	0.1	0.00	0.0
	Mech. man.	36	0.3	0.8	0.06	0.7	0.02	1.1
	Nontraded	200	−0.1	−0.1	−0.01	−0.0	−0.03	−0.1
ODC	Agriculture	983	−2.0	−0.2	−0.37	−0.3	−0.34	−0.2
	Mining	137	0.3	0.2	0.13	0.2	0.04	0.2
	Energy	44	0.1	0.2	0.03	0.2	0.01	0.2
	Nonmech. man.	1456	0.7	0.0	0.07	0.0	0.03	0.1
	Mech. man.	321	0.4	0.1	0.15	0.1	0.03	0.2
	Nontraded	1373	0.4	0.0	−0.02	−0.0	0.19	0.1
OPEC	Agriculture	74	−1.1	−1.5	−0.19	−1.4	−0.13	−1.7
	Mining	23	−0.1	−0.4	−0.01	−0.3	−0.05	−0.5
	Energy	205	1.0	0.5	0.01	0.5	0.38	0.5
	Nonmech. man.	113	−0.3	−0.3	0.00	0.0	−0.03	−0.4
	Mech. man.	13	0.0	0.0	0.01	0.4	−0.01	−0.3
	Nontraded	171	−0.1	−0.1	0.19	0.4	−0.16	−0.4
NIC	Agriculture	145	−2.9	−2.0	−0.39	−2.0	−0.78	−2.0
	Mining	27	0.3	1.1	0.08	1.3	0.10	1.3
	Energy	10	0.1	1.0	0.02	1.0	0.02	1.0
	Nonmech. man.	290	1.2	0.4	0.22	0.4	0.11	0.4
	Mech. man.	61	0.3	0.5	0.06	0.5	0.05	0.6
	Nontraded	402	0.1	0.0	0.01	0.0	0.01	0.0

Table 11.4 continued

		Production			Labor		Capital	
Region	Sector	Base	Change	Percentage change	Change	Percentage change	Change	Percentage change
LDC	Agriculture	491	−2.3	−0.5	−1.20	−0.5	−0.14	−0.6
	Mining	42	0.5	1.2	0.21	1.2	0.10	1.1
	Energy	17	0.1	0.6	0.05	0.8	0.03	0.9
	Nonmech. man.	474	2.1	0.4	0.46	0.5	0.06	0.4
	Mech. man.	19	−0.2	−1.0	−0.02	−0.8	−0.01	−1.9
	Nontraded	512	0.7	0.1	0.51	0.2	−0.04	−0.1

in these negotiations. We ask here if our noncooperative trade war results have any implications for these cooperative negotiations. For concreteness, we focus on the set of possible bilateral agreements that the EC and the United States could negotiate, keeping in mind the results of their agricultural trade war.

Two possible *disagreement points* can be considered. One corresponds to the status quo, and thus generates zero welfare or production improvements for each country. We can then identify the Nash (1950) solution to the bargaining problem. An alternative disagreement point could be the noncooperative NE that was computed earlier; employing this NE as a threat could lead to quite a different outcome of the bargaining problem (in the spirit, if not the letter, of Nash [1953]).[4]

Given the disagreement outcome, it can be shown that the Nash solution (hereafter NS) is the outcome from the feasible set that maximizes the product of the utility gains of each agent relative to the disagreement outcome (see Rapaport 1970, 104ff., for an elementary exposition). In our case we identify the utility of an agent with the values of welfare that were employed previously.

The set of possible agreement points will be all of the possible policy settings considered in all stages of each trade war. Thus, rather than viewing these payoff matrices as the normal form of a noncooperative game (and solving for the NE) we view them as possible agreement points (and solve for the cooperative NS). For simplicity we restrict agreements to the set of pure strategy combinations, and assume that no direct transfers (i.e., side-payments) between the two countries are allowed.

If the disagreement point is assumed to be the status quo, leading to a welfare change of zero for both nations, the NS involves the EC increasing

Table 11.5 Effects of Trade War on Structure of Global Agricultural Trade (change in gross exports [in U.S. $ billions])

	Importing Region							
Region	EC	U.S.	Japan	Canada	ODC	OPEC	NIC	LDC
EC	0.000	−0.600	−0.020	−0.020	−0.280	−0.120	−0.020	−0.110
U.S.	−1.410	0.000	−0.070	−0.040	−0.030	−0.050	−0.110	−0.080
Japan	−0.030	−0.130	0.000	0.000	0.000	0.000	0.000	0.000
Canada	−0.270	−0.460	0.000	0.000	0.010	0.000	−0.010	0.030
ODC	−0.840	−0.860	0.000	0.000	0.000	0.010	−0.030	−0.120
OPEC	−0.330	−0.300	0.000	0.000	0.000	0.000	−0.190	−0.220
NIC	−1.570	−1.320	0.040	0.020	0.060	0.060	0.000	0.000
LDC	−2.200	−0.910	0.030	0.000	0.100	0.100	−0.040	0.000

agricultural protection by 50 percent and the United States increasing it by 100 percent, for welfare payoffs of U.S. $0.76 billion and U.S. $0.55 billion, respectively. Note that these cooperative payoffs are much better for the EC and United States than the noncooperative trade war outcome.

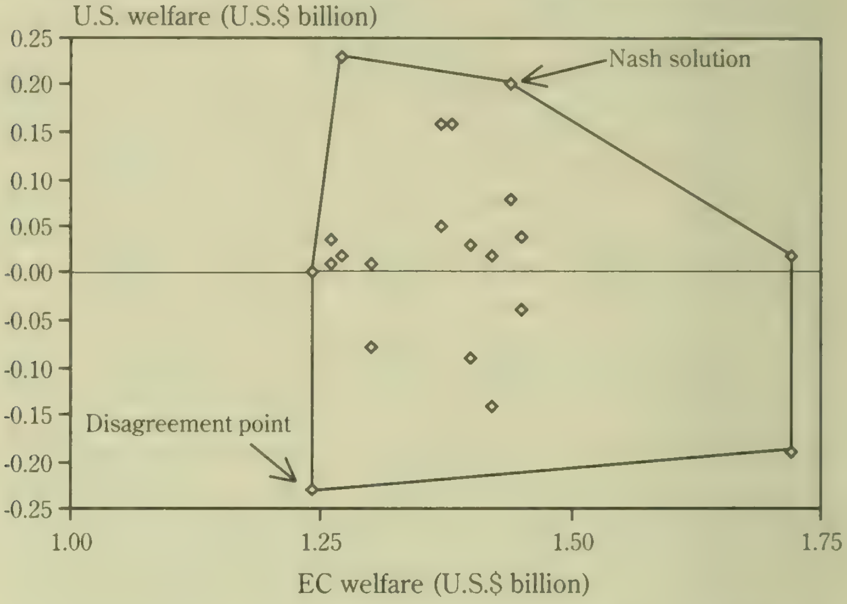
Now assume that the disagreement point is the noncooperative NE of the entire efficiency trade war considered earlier. This NE leads to a welfare gain of U.S. $1.24 billion for the EC and a welfare loss of U.S. $0.22 billion for the United States. Figure 11.1 displays the entire feasible set of agreement points, where a feasible point is one that is a Pareto improvement relative to the disagreement point. Recall that free trade is one of the possible cooperative outcomes considered, although it is not feasible in this sense. Note also that many of the feasible agreement points are Pareto-dominated by other agreement points.

The Nash solution is on the frontier of the set of feasible agreement points, and involves the EC and the United States setting agricultural protection 100 percent higher than currently. In the NS, the EC gains U.S. $1.44 billion and the United States gains U.S. $0.20 billion. The welfare losses for other countries are all less than 1 percent of their respective GNPs.

Escalation of Agricultural Trade Wars

The battle lines of the trade war considered so far have been limited in geographic and sectoral terms. Only the EC and the United States are assumed to engage in retaliatory trade policy actions, and the only actions

Figure 11.1 Transparent Negotiation Set: EC and United States



they consider are with respect to agricultural protection. The possibility that such a trade war will escalate is a serious one in the eyes of many commentators, and has clearly added a note of urgency to the need for multilateral consideration of agricultural policies in the Uruguay Round. Hathaway (1987, 4) argues this point convincingly:

> The experience of the 1980s has shown the extent to which agricultural trade tensions can erupt into wider arenas and other areas of international cooperation. This is not new. Many still remember the famous chicken war between the United States and the European Community (EC) in the 1960s, which threatened all trade and political cooperation among NATO allies. During the 1980s, Japan-U.S. relations have been increasingly strained over agricultural trade issues. In the 1980s we have seen a steady escalation in policy actions designed to offset the actions of others that are asserted to be unfair. Countries too small or too weak economically to engage in trade wars have seen their export earnings plummet and their economies crumble from the side effects of two years of guerrilla trade warfare between the United States and the EC in international grain mar-

> kets. Unless some kind of permanent settlement can be reached, prospects are that these actions will increase.
>
> However unimportant agricultural trade issues appear to many persons, especially in industrial economies, such chronic difficulties on these issues erode cooperation on other international problems. Australia has questioned its continued commitment to U.S. defence installations because of U.S. agricultural subsidies. U.S. credibility on Caribbean Basin development has been undermined by the U.S. sugar import policy. Just as war is too important to be left to generals, agricultural policy—especially as it affects trade—has become too important to be left to ministers of agriculture. The importance of completing a successful trade round that disarms trade disputes in agriculture extends beyond agriculture.

Hathaway (1987, 21) also argues that the possibility of such an agricultural trade war escalation is one of three major reasons that the new round of GATT negotiations attempts some fundamental reform in the area of agriculture.

What would be the effects of a full-blown trade war conducted with across-the-board protection on all imports as the policy variable? Harrison and Rutström (1988) have conducted just such a trade war between the EC, the United States, and Japan using the Whalley model employed here. They find that in the NE of this game the EC would increase protection 1,100 percent for a gain in welfare of U.S. $14.20 billion, the United States would increase protection by 1,800 percent for a welfare gain of U.S. $7.44 billion, and Japan would increase protection by only 200 percent for a welfare loss of U.S. $16.20 billion. These results yet again illustrate the basic point made by Johnson (1954): that retaliatory trade wars are not always losing propositions for all nations.

In this NE, GNP falls heavily in all countries other than the EC and the United States, as does welfare. These changes are qualitatively consistent with the changes in the (commodity) terms of trade for each country. By improving their terms of trade sufficiently, the United States and EC are able to gain on balance from the trade war. It is interesting to note that the NICs lose proportionately the most from this trade war, with a welfare loss of over 10 percent of GNP.

For the purposes of comparison with traditional cost-of-protection measures, Harrison and Rutström (1988, table 3) also report the welfare effects of trilateral and global free trade (across-the-board). The stylized outcome from global abolition is striking. Developing countries are significant losers and developed countries significant gainers. This outcome results from the current high level of trade barriers in place in developing countries. A similarly striking result is obtained when we consider a trilateral abolition of protection by the "Gang of Three"—the EC, the United States, and Japan. In this case the balance sheet of gainers and losers is reversed: the developed countries are significant losers and the developing countries significant gainers.

From a global perspective, however, the total effects of the two free trade policies are about the same: the world gains by U.S. $30–40 billion, or 0.3–0.5 percent of global GNP, from abolishing protection. By comparison, the global effects of protection using the retaliatory NE as the reference point are staggering: the world loses by U.S. $265 billion, or 3.2 percent of global GNP. These results add force to the argument that escalation of an agricultural trade war could be a very serious matter indeed.

Alternative Perspectives

We appreciate that our approach and our results are not definitive. The question of strategic agricultural trade policy is a complex and subtle one, and we seek only to make a conceptual contribution to the understanding of that question. It is appropriate, therefore, for us to discuss briefly a number of alternative ways in which our approach could be formulated or interpreted.

Alternative Payoffs

An alternative exercise to the foregoing would be to study the same kind of trade war using different measures of the payoffs to nations. For example, it is strongly arguable that the United States and the EC are not concerned with broad measures of national welfare when engaging in the current agricultural trade war. Rather, one could imagine that they are concerned with their respective agricultural lobbies. One way to approximate this in the current model is to suggest that governments use the level of domestic agricultural production as the payoff in this agricultural trade war game.[5]

We interpret this substitution as representing the effects of conducting agricultural trade policy on a nonefficient basis: the government ignores the direct effect of its policies on welfare. Table 11.6 contains the single stage of this game and tables 11.7 and 11.8 present the effects. The results are

Table 11.6 One Stage of the Agricultural Trade War: Payoffs in Agriculture and Food Production

Players: EC and U.S.
Strategies: Percentage increases in existing protection on imports of agricultural goods; nondiscriminatory.
Payoffs: Domestic production of agriculture and food (in 1977 U.S. $ billion); NE payoffs in this stage shown in parentheses.

Stage	EC	U.S.
1	20	20
	0	0
	−20	−20
	−40	−40
	−60	−60
	−80	−80
	−100*	−100*
	(401.6)	(477.7)

*Denotes NE.

staggering, especially in comparison with those of the (efficiency) agricultural trade war. We locate a NE in which each of the EC nations and the United States abolish agricultural protection completely. It appears to be in the strategic self-interest of each country to do the right thing by the rest of the world. Although the welfare effect on the EC and the United States is minus U.S. $5.92 billion and minus U.S. $2.09 billion, respectively, the global welfare gain is U.S. $7.8 billion.

An Alternative Instrument

Another alternative to our basic formulation is to analyze the effects of a trade war in which the "instruments" (i.e., strategies) available to each country are the levels of agricultural production subsidies provided to producers. Given the Armington structure of intermediate production and demand in the GE model we use, tariffs and production subsidies are radically different in their direct effects on producer prices in the country imposing them. For example, a 10 percent tariff imposed by the EC on imports of U.S. agriculture will only affect EC producers' prices to the extent that domestic agricultural goods are good substitutes for imported agricultural goods. In contrast, a 10 percent production subsidy immediately drives a 10 percent wedge between the producer price and consumers' prices everywhere in the world.

To illustrate this point we analyzed the effects of offering a 33 percent

Table 11.7 Effects of the Alternative Trade War on Global Production Structure

		Production			Labor		Capital	
Region	Sector	Base	Change	Percentage change	Change	Percentage change	Change	Percentage change
EC	Agriculture	396	21.2	5.4	3.49	5.1	2.85	5.9
	Mining	18	1.8	10.1	0.11	9.9	0.30	10.8
	Energy	107	11.2	10.5	2.58	10.4	1.53	10.6
	Nonmech. Man.	554	20.4	3.7	4.82	3.5	2.32	4.2
	Mech. Man.	317	25.4	8.0	8.73	7.9	1.66	8.8
	Nontraded	1558	−52.6	−3.4	−19.74	−4.0	−11.15	−2.5
U.S.	Agriculture	474	39.1	8.3	5.16	9.3	3.97	7.3
	Mining	54	4.2	7.7	1.31	8.2	0.96	7.3
	Energy	18	0.7	4.0	0.23	4.5	0.08	3.9
	Nonmech. Man.	832	0.5	0.1	0.98	0.5	−0.55	−1.3
	Mech. Man.	464	1.6	0.3	1.05	0.8	−0.25	−1.4
	Nontraded	2150	−38.6	−1.8	−8.74	−1.0	−8.32	−4.8
Japan	Agriculture	180	6.1	3.4	1.68	3.4	0.52	3.4
	Mining	4	0.1	2.6	0.03	2.3	0.04	2.6
	Energy	7	−0.1	−1.5	0.00	0.0	−0.01	−0.4
	Nonmech. Man.	426	−0.3	−0.1	−0.06	−0.1	−0.01	−0.0
	Mech. Man.	219	−5.4	−2.5	−1.07	−2.5	−0.38	−2.4
	Nontraded	730	−1.3	−0.2	−0.59	−0.2	−0.17	−0.1
Canada	Agriculture	22	7.6	34.1	1.90	33.9	0.77	34.5
	Mining	16	−2.3	−14.7	−0.73	−14.8	−0.59	−14.7
	Energy	8	−1.2	−15.6	−0.35	−15.8	−0.28	−15.4
	Nonmech. Man.	132	−0.8	−0.6	−0.23	−0.7	−0.03	−0.4
	Mech. Man.	36	−2.9	−8.2	−0.70	−8.4	−0.14	−7.9
	Nontraded	200	0.9	0.5	0.11	0.2	0.27	0.9
ODC	Agriculture	983	23.6	2.4	4.28	2.9	4.03	2.1
	Mining	137	−3.2	−2.3	−1.37	−2.3	−0.47	−2.7
	Energy	44	−0.9	−2.0	−0.36	−1.9	−0.12	−2.2
	Nonmech. Man.	1456	−5.9	−0.4	−0.56	−0.3	−0.37	−1.1
	Mech. Man.	321	−4.3	−1.3	−1.65	−1.2	−0.34	−2.1
	Nontraded	1373	−5.4	−0.4	−0.38	−0.1	−2.19	−1.7
OPEC	Agriculture	74	12.2	16.4	2.04	14.6	1.51	19.2
	Mining	23	1.1	4.9	0.13	3.5	0.54	5.2
	Energy	205	−10.7	−5.2	−0.14	−6.5	−4.03	−5.2
	Nonmech. Man.	113	2.5	2.2	−0.01	−0.1	0.32	4.0
	Mech. Man.	13	0.1	0.7	−0.06	−2.3	0.09	2.4
	Nontraded	171	0.8	0.5	−1.95	−4.4	1.56	4.0
NIC	Agriculture	145	22.4	15.5	3.06	15.6	6.07	15.5
	Mining	27	−2.6	−9.8	−0.59	−9.5	−0.75	−9.5
	Energy	10	−0.7	−6.7	−0.13	−6.8	−0.14	−7.1
	Nonmech. Man.	290	−8.8	−3.0	−1.62	−3.0	−0.78	−3.1
	Mech. Man.	61	−2.7	−4.4	−0.52	−4.3	−0.40	−4.5
	Nontraded	402	−0.6	−0.1	−0.17	−0.1	−0.15	−0.2

Table 11.7 continued

		Production			Labor		Capital	
Region	Sector	Base	Change	Percentage change	Change	Percentage change	Change	Percentage change
LDC	Agriculture	491	19.8	4.0	10.25	3.9	1.19	5.1
	Mining	42	−4.2	−9.9	−1.70	−10.0	−0.86	−9.6
	Energy	17	−1.1	−6.3	−0.40	−6.1	−0.19	−5.8
	Nonmech. Man.	474	−18.3	−3.9	−3.92	−4.1	−0.50	−3.0
	Mech. Man.	19	1.5	7.8	0.19	7.4	0.05	9.6
	Nontraded	512	−6.2	−1.2	−4.36	−1.8	−0.31	0.7

production subsidy to EC agricultural producers. The effects are presented in tables 11.9, 11.10, and 11.11. One immediately notices two features of these results which contrast with those in which agricultural import restrictions were the strategies. First, the EC suffers a serious welfare loss with the imposition of subsidies to domestic agriculture, whereas it enjoyed a healthy welfare gain when it (unilaterally) increased agricultural trade restrictions. This result follows from the fact that the production-distorting effects of changes in the production subsidy are much stronger than those for unilateral changes in trade restrictions. In addition, there is a welfare-deteriorating terms of trade effect. In an environment such as this, strategic self-interest might well lead to unilateral abolition of subsidies to agriculture.

The second observation relates to the quantitative impacts on trade vol-

Table 11.8 Effects of the Alternative Trade War on Structure of Global Agricultural Trade (change in gross exports [in U.S. $ billions])

	Importing Region							
Region	EC	U.S.	Japan	Canada	ODC	OPEC	NIC	LDC
EC	0.000	6.550	0.390	0.350	3.490	1.460	0.330	1.640
U.S.	23.590	0.000	0.740	0.430	0.230	0.380	1.180	0.780
Japan	0.220	3.420	0.000	0.000	0.000	−0.010	0.030	0.000
Canada	2.850	4.980	−0.020	0.000	0.040	−0.020	0.120	0.180
ODC	9.700	9.660	0.120	0.030	0.000	−0.030	0.270	1.120
OPEC	3.580	3.080	0.030	0.010	0.020	0.000	2.130	2.350
NIC	12.560	10.030	−0.300	−0.080	−0.400	−0.470	0.000	0.000
LDC	19.030	7.460	−0.200	−0.010	−0.750	−0.850	0.280	0.000

Table 11.9 Effects of EC Production Subsidy on Welfare and Terms of Trade

Region	Welfare (EV)	Terms of trade
EC	−2.12	0.53
U.S.	0.05	0.04
Japan	0.22	0.09
Canada	0.07	0.12
ODC	−0.80	−0.43
OPEC	−0.64	−0.33
NIC	−0.01	0.12
LDC	−1.91	−0.26
World	−5.10	

umes and production. A 33 percent subsidy leads to a 28 percent increase in EC agricultural production, and an increase of almost 20 percent in EC agricultural exports.

The difference between the results of the trade restrictions simulation and the subsidies simulation illustrates the general observation made earlier that the results of such Nash games will depend on the instruments which parties are allowed to use. Our results must be interpreted in the light of the fact that countries are assumed to use an instrument which has large terms of trade effects and relatively small domestic-distorting effects (because protection is implicitly imposed on somewhat different commodities than those produced domestically).

Unilateral versus Multilateral Perspectives

In the absence of a country having dominant strategies open to it, the strategic approach to trade policy that we adopt necessarily involves taking a multilateral perspective when assessing what policies are in the self-interest of a country. Many people have argued, however, that such a perspective provides individual countries with an excuse not to consider the welfare costs of domestic policies. If liberalization is viewed as a concession to foreigners, then why unilaterally liberalize and forego the bargaining chip? Now that agriculture is formally slated for discussion during the current GATT multilateral trade negotiations, one might therefore expect countries to be reluctant to liberalize their domestic agricultural policies on a unilateral basis.

Note that there is nothing wrong or irrational with a politician taking this

Table 11.10 Effect of EC Production Subsidy on Global Structure of Production

		Production			Labor		Capital	
Region	Sector	Base	Change	Percentage change	Change	Percentage change	Change	Percentage change
EC	Agriculture	396	82.3	20.8	14.32	20.8	10.11	20.8
	Mining	18	−0.3	−1.7	−0.01	−0.9	−0.03	−1.1
	Energy	107	−2.3	−2.2	−0.53	−2.1	−0.32	−2.2
	Nonmech. Man.	554	−8.7	−1.6	−2.17	−1.6	−0.88	−1.6
	Mech. Man.	317	−8.2	−2.6	−2.87	−2.6	−0.50	−2.7
	Nontraded	1558	−28.5	−1.8	−8.72	−1.8	−8.28	−1.9
U.S.	Agriculture	474	0.6	0.1	0.08	0.1	0.08	0.1
	Mining	54	−0.1	−0.2	−0.01	−0.1	−0.01	−0.1
	Energy	18	−0.1	−0.6	0.00	0.0	0.00	0.0
	Nonmech. Man.	832	0.0	0.0	0.00	0.0	0.00	0.0
	Mech. Man.	464	−0.2	−0.0	−0.05	−0.0	0.00	0.0
	Nontraded	2150	0.1	0.0	−0.01	−0.0	0.02	0.0
Japan	Agriculture	180	0.0	0.0	0.02	0.0	0.01	0.1
	Mining	4	0.0	0.0	0.00	0.0	0.00	0.0
	Energy	7	0.0	0.0	0.00	0.0	0.00	0.0
	Nonmech. Man.	426	−0.1	−0.0	0.00	0.0	−0.01	−0.0
	Mech. Man.	219	0.0	0.0	0.00	0.0	0.00	0.0
	Nontraded	730	0.0	0.0	−0.01	−0.0	0.00	0.0
Canada	Agriculture	22	0.0	0.0	0.02	0.4	0.00	0.0
	Mining	16	−0.1	−0.6	−0.01	−0.2	−0.01	−0.2
	Energy	8	0.0	0.0	0.00	0.0	0.00	0.0
	Nonmech. Man.	132	0.0	0.0	0.00	0.0	0.00	0.0
	Mech. Man.	36	0.0	0.0	−0.01	−0.1	0.00	0.0
	Nontraded	200	0.0	0.0	0.00	0.0	0.00	0.0
ODC	Agriculture	983	0.2	0.0	0.02	0.0	0.02	0.0
	Mining	137	0.0	0.0	−0.02	−0.0	−0.01	−0.1
	Energy	44	0.0	0.0	−0.02	−0.1	−0.01	−0.2
	Nonmech. Man.	1456	−0.3	−0.0	−0.04	−0.0	−0.01	−0.0
	Mech. Man.	321	−0.2	−0.1	−0.08	−0.1	−0.01	−0.1
	Nontraded	1373	0.3	0.0	0.12	0.0	0.01	0.0
OPEC	Agriculture	74	0.2	0.3	0.03	0.2	0.02	0.3
	Mining	23	0.0	0.0	0.00	0.0	0.00	0.0
	Energy	205	−0.2	−0.1	0.00	0.0	−0.07	−0.1
	Nonmech. Man.	113	−0.1	−0.1	−0.01	−0.1	0.00	0.0
	Mech. Man.	13	0.0	0.0	0.00	0.0	0.00	0.0
	Nontraded	171	0.1	0.1	−0.01	−0.0	0.04	0.1
NIC	Agriculture	145	0.4	0.3	0.05	0.3	0.10	0.3
	Mining	27	−0.1	−0.4	−0.01	−0.2	−0.01	−0.1
	Energy	10	0.0	0.0	0.00	0.0	0.00	0.0
	Nonmech. Man.	290	−0.1	−0.0	−0.02	−0.0	0.00	0.0
	Mech. Man.	61	0.0	0.0	0.00	0.0	0.00	0.0
	Nontraded	402	0.0	0.0	−0.02	−0.0	0.01	0.0

Table 11.10 continued

		Production			Labor		Capital	
Region	Sector	Base	Change	Percentage change	Change	Percentage change	Change	Percentage change
LDC	Agriculture	491	0.3	0.1	0.16	0.1	0.02	0.1
	Mining	42	0.0	0.0	0.00	0.0	0.00	0.0
	Energy	17	0.0	0.0	0.00	0.0	0.00	0.0
	Nonmech. Man.	474	−0.1	−0.0	−0.03	−0.0	0.00	0.0
	Mech. Man.	19	−0.1	−0.5	−0.01	−0.4	0.00	0.0
	Nontraded	512	−0.2	−0.0	−0.11	−0.0	−0.01	−0.0

view. We may find the mercantilist underpinning of the argument intellectually unattractive, but if that is the way I expect my negotiating opponents to view things, then I may as well do the best for myself given their attitude. If a country expects to gain more by using the *possibility* of liberalizing as a bargaining chip, then it would indeed be foolish to liberalize unilaterally.

What is perhaps wrong with this argument is the assessment of the probability of a net gain by using liberalization in the future as a bargaining chip. It will undoubtedly take many years for any type of multilateral agreement to come into effect, so the possible benefits of waiting for that agreement (and the accompanying multilateral liberalization) may not be worth the costs of keeping domestic policies in place in the interim. These are judgments that economists are not yet equipped to make, but should be.

It is important to note also that unilateral liberalization is one of the options that we allowed the United States and the EC to adopt in our trade war. We did not take into account the possible future value of nonliberalization as a bargaining chip, and yet we find that these two entities would end up adopting greater agricultural protection than they now do. This result could change, as we have repeatedly indicated, if we were to look at different formulations of the agricultural trade policy game (as we do above).

Different Questions

With our trade war simulations we have addressed the following question: If countries noncooperatively try to improve their own welfare, and are not subject to GATT bindings, what levels of agricultural protection could emerge in a strategic equilibrium? As we know from elementary games such as Pris-

Table 11.11 Effect of EC Production Subsidy on Global Structure of Trade (percentage change in trade)

Exporting region and sector	Importing Region							
	EC	U.S.	Japan	Canada	ODC	OPEC	NIC	LDC
Exports of EC								
Sector 1	0.0	19.6	18.6	19.1	17.8	18.0	19.5	19.1
Sector 2	0.0	−1.3	−1.5	−1.3	−1.5	−1.6	−1.1	−1.7
Sector 3	0.0	−1.8	−2.0	−1.8	−2.0	−2.0	−1.6	−2.1
Sector 4	0.0	−1.6	−1.7	−1.5	−1.6	−1.6	−1.3	−1.9
Sector 5	0.0	−1.9	−2.0	−1.8	−2.0	−2.1	−1.6	−2.1
Capital	0.0	−2.0	−2.2	−2.0	−2.3	−2.4	−1.8	−2.4
Exports of U.S.								
Sector 1	8.1	0.0	−0.2	0.3	−0.8	−0.7	0.6	0.3
Sector 2	−0.6	0.0	−0.2	0.0	−0.2	−0.3	0.3	−0.4
Sector 3	−1.2	0.0	−0.2	0.0	−0.2	−0.3	0.2	−0.4
Sector 4	−0.5	0.0	−0.2	0.0	−0.1	−0.1	0.2	−0.5
Sector 5	−1.0	0.0	−0.2	0.0	−0.2	−0.3	0.2	−0.3
Capital	−1.2	0.0	−0.2	0.1	−0.2	−0.3	0.2	−0.3
Exports of Japan								
Sector 1	8.3	0.8	0.0	0.5	−0.7	−0.5	0.7	0.4
Sector 2	−0.4	0.2	0.0	0.2	0.0	−0.1	0.4	−0.2
Sector 3	−1.0	0.2	0.0	0.2	0.0	−0.1	0.4	−0.2
Sector 4	−0.3	0.1	0.0	0.2	0.1	0.1	0.4	−0.3
Sector 5	−0.8	0.1	0.0	0.2	0.0	−0.1	0.4	−0.1
Capital	−1.1	0.2	0.0	0.2	−0.1	−0.2	0.4	−0.2
Exports of Canada								
Sector 1	7.9	0.5	−0.3	0.0	−1.0	−0.8	0.4	0.1
Sector 2	−0.6	−0.1	−0.2	0.0	−0.3	−0.4	0.2	−0.4
Sector 3	−1.3	−0.1	−0.3	0.0	−0.3	−0.3	0.2	−0.4
Sector 4	−0.5	−0.1	−0.2	0.0	−0.2	−0.2	0.2	−0.5
Sector 5	−1.0	−0.1	−0.2	0.0	−0.2	−0.3	0.2	−0.3
Capital	−1.3	−0.1	−0.2	0.0	−0.3	−0.4	0.2	−0.4
Exports of ODC								
Sector 1	8.3	0.9	0.0	0.4	0.0	−0.5	0.7	0.4
Sector 2	−0.3	0.3	0.1	0.3	0.0	0.0	0.5	−0.1
Sector 3	−0.9	0.2	0.0	0.3	0.0	0.0	0.5	−0.1
Sector 4	−0.2	0.2	0.1	0.3	0.0	0.1	0.5	−0.2
Sector 5	−0.7	0.2	0.1	0.3	0.0	0.0	0.4	0.0
Capital	−1.0	0.3	0.1	0.4	0.0	0.0	0.5	0.0
Exports of OPEC								
Sector 1	8.3	0.9	0.0	0.5	−0.7	0.0	0.7	0.4
Sector 2	−0.3	0.3	0.1	0.4	0.1	0.0	0.6	0.0
Sector 3	−0.9	0.3	0.1	0.4	0.1	0.0	0.6	0.0
Sector 4	−0.2	0.2	0.1	0.3	0.1	0.0	0.5	−0.2

Table 11.11 continued

Exporting region and sector	Importing Region							
	EC	U.S.	Japan	Canada	ODC	OPEC	NIC	LDC
Sector 5	−0.6	0.2	0.2	0.4	0.2	0.0	0.5	0.1
Capital	−0.9	0.4	0.2	0.4	0.1	0.0	0.6	0.0
Exports of NIC								
Sector 1	7.7	0.4	−0.5	−0.1	−1.1	−1.0	0.0	0.0
Sector 2	−0.8	−0.2	−0.4	−0.2	−0.5	−0.6	0.0	−0.6
Sector 3	−1.4	−0.2	−0.4	−0.2	−0.5	−0.5	0.0	−0.6
Sector 4	−0.7	−0.3	−0.4	−0.2	−0.4	−0.4	0.0	−0.7
Sector 5	−1.2	−0.3	−0.4	−0.2	−0.4	−0.5	0.0	−0.5
Capital	−1.5	−0.2	−0.4	−0.2	−0.5	−0.6	0.0	−0.6
Exports of LDC								
Sector 1	8.3	0.9	0.0	0.3	−0.7	−0.5	0.7	0.0
Sector 2	−0.4	0.2	0.0	0.3	0.0	−0.1	0.5	0.0
Sector 3	−1.0	0.2	0.0	0.3	0.0	0.0	0.4	0.0
Sector 4	−0.3	0.2	0.1	0.3	0.1	0.1	0.4	0.0
Sector 5	−1.1	−0.3	−0.3	−0.2	−0.3	−0.4	0.0	0.0
Capital	−1.0	0.3	0.1	0.4	0.0	0.0	0.5	0.0

oner's Dilemma, there is absolutely no presumption that noncooperative strategic (Nash) equilibria lead to Pareto-efficient outcomes. It is possible for countries to change the rules of the trade liberalization game so as to encourage such efficient outcomes, but those types of changes are not considered here. Indeed one can interpret many of the provisions of the GATT as crude attempts to develop such rules; see, for example, McMillan (1986). Changing the rule of a game so as to bring about certain outcomes that are (socially) preferred is a different question from determining what outcomes could emerge from a certain specified set of rules.

It is also important to realize that we are not modeling the way that countries negotiate now. There are many types of constraints on the propensity of countries to engage in the type of retaliatory policy-making that is implied by our trade war. These constraints range from the most mundane of legalities (e.g., GATT bindings) to grander geopolitical considerations.

Repeated Games

We have deliberately chosen to model a very simple game. One feature of the game that might cause some concern about the general validity of our results is the fact that we have analyzed a one-shot or static game that is not repeated. How would our results change if we viewed the game analyzed here as just one stage (one year) in a repeated game between the same players over several stages (multiple years)? The theory of repeated games is much more complicated than the theory of single stage games, and the possible equilibria of the repeated game typically much larger: see Benoit and Krishna (1985), Fudenberg and Maskin (1986), and Abreu (1988) for important contributions.

The so-called Folk Theorem of repeated games says that many possible equilibrium outcomes are possible in the repeated game that may not be equilibria of the single-stage game. The essential idea behind this is that players can devise "punishment rules" to impose on any player that deviates from any prescribed equilibrium path of the repeated game. The only paths that cannot be protected with these sorts of punishments are paths in which one player gets worse than he could even if all of the other players cooperated in punishing him the most (the player's "minimax outcome").

The reason that this result is important, in the present context, is that it provides one possible way in which Pareto-preferred multilateral liberalization strategies might come about even if they are not NE in a single stage game. If one country deviates from this liberalization strategy, the other players enact punishments that make the would-be deviant worse off than if he deviated without any such punishments being invoked. It can be argued that many of the provisions of the GATT can be interpreted in this way—as prescribed punishment rules for nations that deviate in certain ways.

Is this another case in which game theory allows one to prove any results one likes, without any possibilities being ruled out? Not quite. For simplicity we concentrate on the case in which the game is to be repeated a finite number of times; this number may be arbitrarily large, but it must be finite.

First it should be noted that one of the equilibria of the repeated game will always be just to repeat the single stage NE. This is called "the trivial equilibrium" by game theorists, not because it is uninteresting, but because it is stationary and perhaps an obvious equilibrium. However, even though it is obvious from a formal point of view it provides a natural benchmark for analysis. Second, if the single stage NE is unique then the only equilibrium of the repeated game is this trivial equilibrium. This is a very important result, emphasized by Benoit and Krishna (1985, 910) and Moreaux (1985). The simple logic behind this result is as follows. In the last period the players will not deviate from the single stage NE, since the only reason to deviate from a

NE (in earlier periods) and forgo some expected payoff is to punish some other player for deviating. That is, to threaten to punish someone by undertaking an action that causes me to forgo some expected payoff in the final period is not credible. When we actually get to the last period you will not expect me actually to undertake my threat, since the game ends in that period. (Formally, we are evaluating perfect equilibria of the repeated game.)

Now consider the next-to-last period of the repeated game. What can I use as a threat to stop you deviating in this period? I cannot threaten to punish you in the final period by the above logic, and you are aware of that! All I can credibly threaten you with is that I will play my NE strategy in the final period. Hence nobody can be punished if they deviate in the next-to-last period, since it is in nobody else's best interest to punish them in the last period. If no player can be punished for a deviation in the NE, each player will do what is in his best interest to do in each period. That is just a definition of the single stage NE. So we have proved the result that the only equilibrium of the repeated game is in fact the trivial NE of the single stage game.

The reason that this argument is so important here is that all of the games that we have studied had unique NE in their single stages. Hence we know that the only equilibrium of the repeated game is the outcome we found as the NE of the single stage game. (Note that the NE only has to be unique in terms of the payoffs it generates for all players; there could be any number of NE strategy combinations as long as they all generate the same unique payoff vector.)

We do not want to claim that the only repeated game of interest is the finite horizon complete-information game we study here. If the time horizon is infinite or there exists some uncertainty about the payoffs (for example), the Folk Theorem does indeed open up a Pandora's box of possible equilibrium outcomes over time. The empirical relevance of these possibilities is not yet established, however, and they provide a flimsy basis for rationalizing a multilateral liberalization strategy as the equilibrium of some repeated game.

Sensitivity Analysis

Finally, we can ask how sensitive are our results to the particular model assumed to generate our payoff matrices? Elsewhere we have argued strenuously for the ritual systematic evaluation of the sensitivity of a given model to variations in key parameters, especially elasticities (see Harrison et al. 1987). Conducting such a sensitivity analysis with the model we use would not change our basic qualitative results, although of course the particular numbers would change slightly.

The same logic compels us to examine sensitivity to a complete change in model. As a further illustration of our approach, we consider the use of the agricultural model of Tyers and Anderson (1988a; 1988b). This model has several advantages for our purposes, not the least being a detailed modeling of agricultural policies and storage activities in an explicit manner. Moreover, it has been widely cited in the current policy debate. It does not model general equilibrium interactions, however, and welfare measures in particular are based on partial equilibrium evaluations of consumer and producer surplus for agriculture only.

Table 11.12 presents the payoff matrices for two simple games that are based on simulations reported from Tyers and Anderson (1988a, table 5). Game 3 uses Net Economic Welfare to measure payoffs, this being their analogue to our welfare measure. Game 4 uses Producer Welfare to measure payoffs, on the grounds (discussed earlier) that nations are not conducting agricultural policy for the benefit of their citizens but for the narrow benefit of sectional agricultural lobby interests. This measure of producer welfare is in many respects more appropriate than the measure used in the game we studied in tables 11.6–11.8 (we used agricultural production as a proxy for producer welfare). Their simulations refer to the effects on these variables in 1980–1982, expressed in billions of 1985 U.S. dollars.

One important qualification to these results concerns the interpretation of the cell in the payoff matrices corresponding to joint abolition by the United States and the EC. Tyers and Anderson (1988a) report only the results of a multilateral liberalization by All Industrial Market Economies, which includes Japan, EFTA, Canada, and Australia. Therefore, this cell will only approximate the correct value roughly.[6]

The NE of these games are transparent. In game 3 the pure strategy NE is for both countries to liberalize, and in game 4 for both countries to do nothing. Note that these are exactly the opposite of the qualitative results that we obtained earlier.

These results do suggest, as we have repeatedly argued, that our results are dependent on the model that one uses, the motivating force behind agricultural policy (broad notions of welfare or narrow sectional notions), and the nature of the instruments that policymakers have at their disposal. Intervention in the Tyers-Anderson model represents both trade and domestic distortions.

This is not the place to undertake a critical comparative evaluation of the

Table 11.12 Agricultural Trade Games Based on the Tyers-Anderson Model

Game 3: Net Economic Welfare as the payoff

	EC payoffs		U.S. payoffs	
	U.S.^{N}	US^A	U.S.^{N}	US^A
EC^N	0.0	−0.9	0.0	3.2
EC^A	8.9	7.5	−0.1	2.7

Game 4: Producer Welfare as the payoff

	EC payoffs		U.S. payoffs	
	U.S.^{N}	U.S.^{A}	U.S.^{N}	U.S.^{A}
EC^N	0.0	5.2	0.0	−16.9
EC^A	−47.3	−35.3	11.6	0.2

two models used here. Each has its strengths and weaknesses for different questions. To claim that one or the other is more realistic for present purposes is an egregious exercise in polemics. Our contribution to that debate will take the form of constructing new general equilibrium models of global agricultural trade policy that allow for the specific forms of intervention used in agriculture and the lobbying forces that underlie policy formation in this field.

Conclusions

We illustrate a conceptual and quantitative approach to the analysis of agricultural trade wars. As we have emphasized throughout, the "wars" analyzed here are highly stylized representations of actual conflict. We do, however, illustrate the importance of several considerations to the outcome of the trade war: (1) the instruments available to the policymaker, (2) the objectives of the respective policymakers, (3) the game theoretic solution concept used, and (4) the features of the numerical model used for evaluating payoffs. Our results suggest that international agreements such as the GATT are most important to the elimination of trade restrictions in situations in which the strategic self-interest of parties does not lead them to unilaterally liberalize. At the same time we give an example where strategic self-interest could lead to unilateral liberalization.

Appendix A

Table 11A.1 Effects of Trade War on Global Structure of Trade: Change in Trade (in U.S. $ billion)

Exporting Region and Sector	Importing Region							
	EC	U.S.	Japan	Canada	ODC	OPEC	NIC	LDC
Exports of EC								
Sector 1:	0.000	−0.600	−0.020	−0.020	−0.280	−0.120	−0.020	−0.110
Sector 2:	0.000	0.000	−0.010	0.000	−0.050	0.000	0.000	−0.080
Sector 3:	0.000	−0.010	0.000	0.000	−0.170	−0.010	0.000	0.000
Sector 4:	0.000	−0.060	−0.070	−0.050	−1.150	−0.310	−0.250	−0.600
Sector 5:	0.000	−0.050	−0.040	−0.040	−0.700	−0.380	−0.380	−0.500
Capital:	0.000	0.000	−0.020	−0.010	0.000	0.090	0.000	−0.010
Exports of U.S.								
Sector 1:	−1.410	0.000	−0.070	−0.040	−0.030	−0.050	−0.110	−0.080
Sector 2:	0.040	0.000	−0.060	−0.030	−0.010	0.000	−0.110	−0.160
Sector 3:	0.010	0.000	−0.020	−0.010	0.000	0.000	−0.030	0.000
Sector 4:	0.100	0.000	−0.030	−0.130	−0.080	−0.050	−0.200	−0.100
Sector 5:	0.130	0.000	−0.020	−0.260	−0.100	−0.100	−0.280	−0.110
Capital:	0.000	0.000	−0.050	−0.040	0.000	−0.240	0.000	−0.060
Exports of Japan								
Sector 1:	−0.030	−0.130	0.000	0.000	0.000	0.000	0.000	0.000
Sector 2:	0.000	0.000	0.000	0.000	0.000	0.000	−0.010	−0.020
Sector 3:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sector 4:	0.080	0.120	0.000	0.000	0.020	0.020	−0.160	−0.230
Sector 5:	0.180	0.300	0.000	0.000	0.020	0.030	−0.140	−0.050
Capital:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Exports of Canada								
Sector 1:	−0.270	−0.460	0.000	0.000	0.010	0.000	−0.010	−0.030
Sector 2:	0.060	0.130	0.000	0.000	0.010	0.000	−0.020	−0.010
Sector 3:	0.000	0.090	0.000	0.000	0.000	0.000	0.000	0.000
Sector 4:	0.040	0.200	0.000	0.000	0.000	0.010	−0.020	0.000
Sector 5:	0.010	0.260	0.000	0.000	0.000	0.010	−0.010	0.000
Capital:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Exports of ODC								
Sector 1:	−0.840	−0.860	0.000	0.000	0.000	0.010	−0.030	−0.120
Sector 2:	0.310	0.020	−0.010	0.000	0.000	0.000	−0.030	−0.030
Sector 3:	0.070	0.000	−0.100	0.000	0.000	0.000	−0.100	0.000
Sector 4:	1.060	0.130	0.000	−0.010	0.000	0.010	−0.060	−0.060
Sector 5:	0.560	0.080	0.000	0.000	0.000	0.010	−0.070	−0.020
Capital:	0.000	0.000	0.000	−0.010	0.000	0.070	0.000	−0.030
Exports of OPEC								
Sector 1:	−0.330	−0.300	0.000	0.000	0.000	0.000	−0.190	−0.220
Sector 2:	0.020	0.010	0.000	0.000	0.000	0.000	−0.080	−0.080

Table 11A.1 continued

Exporting Region and Sector	Importing Region							
	EC	U.S.	Japan	Canada	ODC	OPEC	NIC	LDC
Sector 3:	1.040	0.470	−0.100	−0.020	−0.030	0.000	−0.160	−0.150
Sector 4:	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sector 5:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Capital:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Exports of NIC								
Sector 1:	−1.570	−1.320	0.040	0.020	0.060	0.060	0.000	0.000
Sector 2:	0.140	0.020	0.030	0.000	0.000	0.010	0.000	0.000
Sector 3:	0.000	0.050	0.010	0.010	0.010	0.010	0.000	0.000
Sector 4:	0.330	0.440	0.050	0.050	0.090	0.030	0.000	0.000
Sector 5:	0.070	0.160	0.010	0.010	0.020	0.010	0.000	0.000
Capital:	0.000	0.000	0.060	0.030	0.000	0.400	0.000	0.020
Exports of LDC								
Sector 1:	−2.200	−0.910	0.030	0.000	0.100	0.100	−0.040	−0.000
Sector 2:	0.170	0.050	0.050	0.000	0.020	0.050	−0.010	0.000
Sector 3:	0.010	0.000	0.050	0.000	0.000	0.020	0.000	0.000
Sector 4:	0.730	0.350	0.030	0.010	0.160	0.040	−0.010	0.000
Sector 5:	0.020	0.010	0.000	0.000	0.000	0.000	0.000	0.000
Capital:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 11A.2 Effects of Trade War on Global Structure of Trade: Percentage Change in Trade

Exporting Region and Sector	Importing Region							
	EC	U.S.	Japan	Canada	ODC	OPEC	NIC	LDC
Exports of EC								
Sector 1:	0.0	−35.4	−5.9	−6.2	−5.6	−5.6	−9.2	−8.1
Sector 2:	0.0	0.2	−2.2	−2.1	−2.0	−1.9	−5.0	−3.8
Sector 3:	0.0	−0.9	−2.7	−2.6	−2.5	−2.5	−5.4	−4.2
Sector 4:	0.0	−0.6	−3.0	−3.2	−2.6	−2.7	−5.9	−4.9
Sector 5:	0.0	−0.7	−2.7	−2.8	−2.5	−2.3	−5.7	−4.1
Capital:	0.0	−1.1	−2.9	−3.3	−2.9	−2.6	−5.5	−4.4
Exports of U.S.								
Sector 1:	−34.7	0.0	−3.4	−3.6	−3.1	−3.1	−6.7	−5.6
Sector 2:	0.9	0.0	−1.7	−1.9	−1.5	−1.5	−4.6	−3.3
Sector 3:	1.3	0.0	−1.7	−1.6	−1.5	−1.5	−4.4	−3.3
Sector 4:	1.2	0.0	−1.8	−1.9	−1.4	−1.5	−4.7	−3.7
Sector 5:	1.5	0.0	−1.6	−1.8	−1.4	−1.2	−4.7	−3.0
Capital:	1.4	0.0	−1.6	−2.0	−1.6	−1.3	−4.3	−3.1

Table 11A.2 continued

Exporting Region and Sector	Importing Region							
	EC	U.S.	Japan	Canada	ODC	OPEC	NIC	LDC
Exports of Japan								
Sector 1:	−31.3	−40.5	0.0	−0.2	0.3	0.3	−3.5	−2.4
Sector 2:	2.7	2.4	0.0	0.1	0.2	0.3	−2.9	−1.6
Sector 3:	3.1	1.9	0.0	−0.4	0.2	0.3	−2.8	−1.6
Sector 4:	3.1	2.5	0.0	−0.1	0.4	0.3	−3.0	−1.9
Sector 5:	3.2	2.1	0.0	−0.2	0.3	0.5	−3.0	−1.4
Capital:	3.1	1.9	0.0	−0.4	0.1	0.4	−2.7	−1.5
Exports of Canada								
Sector 1:	−31.8	−37.1	0.2	0.0	0.5	0.5	−3.3	−2.2
Sector 2:	3.0	2.8	0.3	0.0	0.6	0.6	−2.6	−1.3
Sector 3:	3.4	2.2	0.3	0.0	0.5	0.6	−2.4	−1.2
Sector 4:	3.2	2.6	0.1	0.0	0.5	0.4	−2.9	−1.8
Sector 5:	3.3	2.2	0.2	0.0	0.4	0.6	−3.0	−1.3
Capital:	3.5	2.3	0.4	0.0	0.5	0.8	−2.3	−1.1
Exports of ODC								
Sector 1:	−32.1	−37.0	−0.2	−0.5	0.0	0.2	−3.6	−2.5
Sector 2:	2.5	2.3	−0.1	−0.5	0.0	0.1	−3.0	−1.8
Sector 3:	2.9	1.7	−0.2	0.0	0.0	0.1	−2.9	−1.7
Sector 4:	2.9	2.3	−0.1	−0.3	0.0	0.2	−3.1	−2.1
Sector 5:	3.0	1.9	−0.1	−0.1	0.0	0.3	−3.2	−1.6
Capital:	3.1	1.9	0.0	−0.4	0.0	0.3	−2.7	−1.5
Exports of OPEC								
Sector 1:	−31.8	−36.3	−0.5	−0.6	−0.1	0.0	−3.9	−2.8
Sector 2:	2.3	2.0	−0.4	−0.3	−0.2	0.0	−3.3	−2.0
Sector 3:	2.6	1.4	−0.4	−0.8	−0.2	0.0	−3.2	−2.0
Sector 4:	2.6	2.0	−0.4	−0.6	−0.1	0.0	−3.4	−2.4
Sector 5:	2.7	1.7	−0.3	−0.4	−0.2	0.0	−3.5	−1.8
Capital:	2.6	1.4	−0.5	−0.9	−0.4	0.0	−3.1	−2.0
Exports of NIC								
Sector 1:	−29.8	−34.4	2.5	2.2	2.8	2.8	0.0	0.1
Sector 2:	5.3	5.0	2.6	2.5	2.8	2.8	0.0	0.9
Sector 3:	5.5	4.3	2.4	2.5	2.6	2.6	0.0	0.8
Sector 4:	5.7	5.0	2.5	2.3	2.9	2.8	0.0	0.5
Sector 5:	5.5	4.4	2.3	2.3	2.5	2.7	0.0	0.8
Capital:	6.1	4.8	2.9	2.5	2.9	3.2	0.0	1.3
Exports of LDC								
Sector 1:	−30.4	−34.9	1.6	1.3	1.9	1.9	−1.9	0.0
Sector 2:	4.2	3.9	1.5	1.6	1.7	1.7	−1.5	0.0
Sector 3:	4.5	3.3	1.4	1.0	1.6	1.7	−1.4	0.0

Table 11A.2 continued

Exporting Region and Sector	Importing Region							
	EC	U.S.	Japan	Canada	ODC	OPEC	NIC	LDC
Sector 4:	4.6	3.9	1.5	1.2	1.8	1.8	−1.6	0.0
Sector 5:	3.2	2.1	0.1	0.0	0.3	0.5	−3.0	0.0
Capital:	4.8	3.6	1.6	1.3	1.7	2.0	−1.1	0.0

Notes

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1. There have been a number of previous numerical studies of trade retaliation in the context of simple general equilibrium models: see, for example, Kuga (1973), Hamilton and Whalley (1983), Kennan and Riezman (1984) and Tower, Sheer, and Baas (1978). Most of the inspiration for this research can be attributed to the classic study by Johnson (1954), in which he pointed out the possibility of one country being a net gainer in a Bertrand-Nash Equilibrium after retaliation. The general literature on game theory in international economics is well reviewed by McMillan (1986).

2. This latter conclusion is based on the trilateral trade war evaluated in Harrison and Rutström (1988). That trade war considered across-the-board protection levels as the policy instrument, welfare as the payoff, and included Japan as a strategic actor (along with the EC and United States). The investigators found that Japan increased protection in the NE only slightly compared to the United States and EC, and that she had a dominant strategy to stay at that level of protection. We should also note that the computational expense of evaluating the payoff matrix for a trilateral trade war vastly exceeds the expense for a bilateral trade war, although this expense is dependent on the underlying GE model, of course.

3. This discrete multistage computational procedure does have some potential problems, which are discussed in Harrison and Rutström (1988). These problems concern the need to assume that payoffs are globally monotonic to ensure that one has found a unique NE with our procedures. In order to ensure that we had not missed a NE at a much higher level of agricultural protection, we also ran an additional stage in which each country could increase protection by 0 percent, 500 percent, 1,000 percent, 1,500 percent, and 2,000 percent. The sole NE of this game is for each country not to change protection at all. These values of protection increase were chosen because they span the range of across-the-board protection levels in NE of the trilateral trade between the EC, United States, and Japan reported in Harrison and Rutström (1988).

4. There are many ways to solve bargaining games. We have selected the Nash (1950) solution as the obvious and popular choice for present purposes. An axiomatic

solution, such as the Nash solution, has the advantage of attempting to characterize the outcome of a wide range of distinct bargaining processes. Strategic approaches to bargaining games are typically very sensitive to the exact extensive form representation of the process. Moreover, there are numerous noncooperative strategic rationalizations of the outcome predicted by the Nash (1950) solution; see, for example, Nash (1953), Harsanyi (1977), Binmore, Rubinstein, and Wolinsky (1986), and van Damme (1986).

5. Our approach could also incorporate the treatment of strategic lobbies—political parties and voters that underlie recent models of tariff formation (e.g., see Rutström 1987 and Young and Magee 1986). We are anxious to construct new GE trade models that explicitly capture the rent-seeking process in a more politically plausible way. To some extent we can consider the effects of alternative payoff measures in trade war games by substituting other measures for national welfare, as we do here, but this is not as satisfactory as we would like.

6. In a private communication Rod Tyers has generously provided us with the results of the "correct" policy simulation for this cell in game 3. The conclusions we draw as to the NE outcome do not change; therefore we use the values that are documented in the published literature. The correct values for the corresponding cell in game 4 are not known at this stage; hence we do not know if our conclusion with respect to it would change.

References

Abreu, D. 1988. On the theory of infinitely repeated games with discounting. *Econometrica* 56:383–96.

Benoit, J. P., and V. Krishna. 1985. Finitely repeated games. *Econometrica* 55:905–22.

Binmore, K. A., Rubinstein, and A. Wolinsky. 1986. The Nash bargaining solution in economic modelling. *Rand Journal of Economics* 17:176–88.

Commission of the European Communities 1987. *Twentieth general report on the activities of the European Communities 1986.* Brussels: Office for Official Publications of the European Communities.

Corden, W. M. 1971. *The theory of protection.* Oxford: Clarendon Press.

Fudenberg, D., and E. Maskin. 1986. The Folk Theorem in repeated games with discounting or with incomplete information. *Econometrica* 54:533–54.

Hamilton, B., and J. Whalley. 1983. Optimal tariff calculations in alternative trade models and some possible implications for current world trading arrangements. *Journal of International Economics* 15:323–48.

Hansen, T. 1974. On the approximation of Nash Equilibrium points in an N-person non-cooperative game. *SIAM Journal of Applied Mathematics* 26:622–37.

Harrison, G. W., R. Jones, L. J. Kimbell, and R. Wigle. 1987. How robust is applied general equilibrium analysis?. Centre for the Study of International Economic Relations, Department of Economics, University of Western Ontario, Working Paper no. 8707C. London, Ontario.

Harrison, G. W., and E. E. Rutström. 1988. Trade wars, trade negotiations and applied game theory. Department of Economics, University of New Mexico. Typescript.

Harsanyi, J. C. 1977. *Rational behaviour and bargaining equilibrium in games and social situations*. Cambridge: Cambridge Univ. Press.

Hathaway, D. E. 1987. *Agriculture and the GATT: Rewriting the rules*. Washington D.C.: Institute for International Economics.

Johnson, H. G. 1954. Optimum tariffs and retaliation. *Review of Economic Studies* 21:142–53. Reprinted with revisions in H. G. Johnson. 1958. *International trade and economic growth*. Cambridge, Mass.: Harvard Univ. Press.

Kennan, J. and Riezman, R. 1984. Do big countries win tariff wars? Department of Economics, University of Iowa, Working Paper no. 84-33. Iowa City.

Kuga, K. 1973. Tariff retaliation and policy equilibrium. *Journal of International Economics* 3:351–66.

Markusen, J. R. and J. R. Melvin. 1984. *The theory of international trade and its Canadian applications*. Toronto: Butterworths.

Markusen, J. R. and R. M. Wigle. 1987. Nash-equilibrium tariffs for the U.S. and Canada, and associated welfare gains/losses. Department of Economics, University of Western Ontario. Typescript.

McMillan, J. 1986. Game Theory in International Economics. New York and Chur, Switzerland: Harwood Academic Publishers.

Moreaux, M. 1985. Perfect Nash equilibria in finite repeated games and uniqueness of Nash equilibrium in the constituent game. *Economics Letters* 17:317–20.

Nash, J. F. 1950. The bargaining problem. *Econometrica* 18:155–62.

———. 1951. Noncooperative games. *Annals of Mathematics* 54:286–95.

———. 1953. Two-person cooperative games. *Econometrica* 21:128–40.

Rapaport, A. 1970. *Two-person game theory*. Ann Arbor: Univ. of Michigan Press.

Rutström, E. E. 1987. Rationalizing protectionism. A computable general equilibrium study of Indonesia. Department of Economics, Stockholm School of Economics.

Tower, E., A. Sheer, and H. J. Baas. 1978. Alternative optimum tariff strategies as devices for transferring real incomes. *Southern Economic Journal* 44 (July): 18–31.

Tyers, R., and K. Anderson. 1988a. Liberalising OECD agricultural policies in the Uruguay Round: Effects on trade and welfare. *Journal of Agricultural Economics* 39, no. 2 (May): 197–216.

Tyers, R., and K. Anderson 1988b. Distortions in world food markets. Cambridge: Cambridge Univ. Press.

van Damme, E. 1986. The Nash bargaining solution is optimal. *Journal of Economic Theory* 38:78–100.

Whalley, J. 1985. *Trade liberalization among world trading areas*. Cambridge, Mass.: MIT Press.

———. 1986. Impacts of a fifty percent tariff reduction in an eight-region global trade model. In *Issues in trade policy modelling*, ed. T. N. Srinivasan and J. Whalley. Cambridge, Mass.: MIT Press.

Young, L. and S. P. Magee. 1986. Endogenous protection, factor returns, and resource allocation. *Review of Economic Studies* 53 (July):407–20.

Index

Abreu, D., 357
Adelman, I., 51, 222
Agricultural assistance, Australia, 297–300; to input, 300; macroeconomic effects of removal, 301–4; to output, 297–99; sector effects of removal, 306–10; to value adding factors, 298–300. *See also* Manufacturing assistance, Australia
Agricultural Basic Law, Japan, 177
Agricultural liberalization
—in the EC: consumption effects, 113; effects on small and large farms, 109; employment effects, 112–13; income effects, 113; money transfer effects, 114–15; sector effects, 111–12
—in Germany: effects on land prices, 144; effects on trade, 146; employment effects of, 142; full liberalization, 143, 144; macroeconomic consequences of, 142–43; sector effects of, 144–45. *See also* German agriculture
—in industrial countries: efficiency effects on LDCs, 27–28, 65; effects on LDC debt repayment capacity, 66
—in Japan: effects of, 185–93; effects on agriculture, 190–92; effects on farm income, 192; effects on land prices, 191–92; effects on manufactured exports, 190–92. *See also* Japanese agriculture
—in the United States. *See* Agricultural subsidies, U.S.: removal of; U.S. agricultural liberalization: effects of in Hertel model *and* effects of in Robinson et al. model
—in the world. *See* Tyers-Anderson model of world agricultural liberalization
Agricultural protection
—effect of economic growth on, 156
—in Japan: effects on trade surplus, 193–96; history, 177; nominal rate of, 179; PSE equivalent of, 179; reasons for, 177; instruments of, 179–80. *See also* Quantitative import barriers, Japan
—in Korea: effects of removal, 164–69; instruments of, 163; policy objectives, 160. *See also* Vincent model: Korea
Agricultural subsidies, U.S., 202, 205–7, 225–26. *See also* Export enhancement program, U.S.

—acreage reduction programs, 227. *See also* Set-aside programs, U.S.
—deficiency payments, 226
—loan rate, 227
—money spent on, 206–7
—payment in kind (PIK) to farmers, 263
—removal of (Feltenstein model): budgetary implications, 216; effects on trade deficit, 216; macroeconomic effects, 213–15; subsidies modeled, 202. *See also* Feltenstein model, U.S.
—sugar industry support, 262
—target price, 227
Agricultural trade problem: root cause of, 10–11; strategy for reform of, 11–12
Agricultural trade war. *See* Trade war, agricultural
Agriculture, U.S. Department of (USDA), 55, 57, 99, 157, 178, 225, 228, 268, 293
Allocative efficiency gains, 198 n.14
Anderson, K., 24, 25, 36, 60, 99, 131, 156, 160, 181, 251, 359
Andriessen, F., 105
Armington assumption: in Japan model, 184; in Hertel model, 267–68, 284; in Feltenstein model, 212; in Whalley model, 349
Asian economies: agriculture in, 153–54; growth performance, 153–54; rates of agricultural protection, 157–58
Assistance removal, Australia. *See* Agricultural assistance, Australia
Australian Bureau of Agricultural and Resource Economics (ABARE), 98, 117, 119, 120
Australian National Farmers' Federation, 295
Australian Trade Practices Act, 299

BAE. *See* Australian Bureau of Agricultural and Resource Economics (ABARE)
Bale, M., 181
Ballard, C., 70, 283, 287
Ballenger, N., 293
Ball, V., 283
Bank of Korea, 161
Benoit, J., 357
Bertrand-Nash Equilibrium, 364. *See also* Nash Equilibrium
Booming sector theory, 169 n.2
Boyd, R., 266, 279
Breckling, J., 3, 32, 36, 37, 38, 94, 95, 98, 99, 102, 105, 106, 107, 113, 117, 121, 122, 123
Breckling, Thorpe, and Stoeckel model, EC, 105–23; behavioral postulates, 106; countries and sectors, 105–6; data base, 121–22; elasticities, 122–23; primary factors, 106; simulation shocks, 119–21
Brigden, J., 295
Bruce, I., 317
Bundesverband der Deutschen Industrie. *See* Federation of German Industry
Burniaux, J., 25

Cairns group, 31, 295
CAP prices and producer prices. *See* Common Agricultural Policy
Carmichael, W., 295
Caves, R., 83
Chattin, B., 278
Centre for International Economics, 161
Citibank, 24
Clements, K., 19, 23, 97
Closure of models, interpretation of, 16–17
Cobb-Douglas functions, 230
Cobb, M., 295
Codsi, G., 296
Commission of the European Communities, 101, 102, 104, 119, 120, 121
Commodity Credit Corporation (CCC), U.S., 45, 206, 225, 261

Common Agricultural Policy (CAP): CAP prices and producer prices in France and Germany, 137; effects on EC employment (*see* Agricultural liberalization: in the EC); effects on EC net exports, 94; effects on money transfers (*see* Agricultural liberalization: in the EC); financial cost to taxpayers, 119; instruments of, 117–18, 141; link to EC unemployment, 112; member contributions and receipts, 99–100; need for reform, 96; objectives of, 117; origins, 135–36; present state of, 125; reasons for slow reform, 97; role of national policies in, 125–26
Computable general equilibrium (CGE) model: general features, 224
Conservation Reserve Program, U.S., 263
Cooper, R., 300
Council of Agricultural Ministers, EC, 130, 136
Council of Economic Advisers, U.S., 262

Davos proposal of Australian prime minister, 295
Deaton, A., 122
de Melo, J., 283
Dervis, K., 283
Dicke, H., 3, 32, 34, 35, 36, 37, 125, 136, 182
Diewert, W., 277
Dixon, P., 161, 182, 295
Domestic self-interest in agricultural reform, 15. *See also* Domestic transparency: role in agricultural reform
Domestic transparency: role in agricultural reform, 9–10
Donges, J., 125, 137, 140, 145
Duchene, F., 96
Dunmore, J., 293
Dynamic gains, 17, 198 n.14

EC. *See* European Community
EC Commission, 117, 136, 179
EC Council, 136
Economic Report of the President, 219
Economic Research Service (ERS), U.S. Department of Agriculture, 18
Economywide constraints. *See* Economywide links
Economywide links: direct, 19–21; indirect, 20–21
Edwards, G., 295
Eminent Persons Committee, 18
European Agricultural Guidance and Guarantee Fund, 119
European Community (EC)
—agricultural protection by: domestic-world price differentials, 132–33; effects on EC manufacturing and services, 98. *See also* Breckling, Thorpe, and Stoeckel model, EC; Common Agricultural Policy
—labor market rigidities in, 102–5
—large and small farms in, 101–2
—output by sector, 99–100
—transfers to agriculture, value of, 98, 107. *See also* Common Agricultural Policy
—unemployment in: barrier to agricultural reform, 105
European Parliament Secretariat, 107
Export enhancement program, U.S., 226, 228, 257 n.24; modeling of, 226. *See also* Agricultural subsidies, U.S.

Farm Accountancy Data Network (Eurostat), 122
Farm Bill, U.S.: of 1981, 263; of 1985, 50, 224, 227, 237, 240, 241, 243, 260, 263, 266
Farm Credit System, U.S., 266
Farmers Federation, Germany, 33, 125, 129, 134, 135, 136
Farmers Home Administration, U.S., 206

Farm Law 1955, Germany, 128, 131, 134
Federation of German Industry, 129, 135
Feltenstein, A., 3, 46, 47, 48, 49, 50, 52, 200
Feltenstein model, U.S., 207–19; closure, 210; consumption behavior, 209–10; export elasticities, 213; financing central government, 211; foreign sector, 211; macroeconomic mechanisms, 204–5; money demand in, 213, 218; production behavior, 207–9; savings constraint, 220 n.10; sectors, 212; technical specification, 217–19; validation of, 214
Fisherian response, 215
Folk Theorem of repeated games, 357
Food Agency, Japan, 180
Food Security Act 1985, U.S., 206, 227
Francis, S., 122
Fudenberg, D., 357
Full liberalization, Germany. *See* Agricultural liberalization: in Germany
Fuss, M., 277

GEMPACK software, 296
General Agreement on Tariffs and Trade (GATT), 18, 134, 147, 243, 244, 246, 315, 331, 332, 338, 342, 347, 354, 356, 357, 360
Gerken, E., 99, 125
German agriculture: budget programs for, 129–30; importance in economy, 125; land values, 135; public subsidies to, 125, 130–31; world-domestic price gaps, 131. *See also* Agricultural liberalization: in Germany; German model
German farmers: compensation for wealth losses, 147; income comparisons with other households, 134; income of, 126; part-time/full-time, 133; wealth of, 133 (*see also* German agriculture: land values)
German Farmers Federation, 33, 125, 129, 134, 135, 136
German Farm Law 1955, 128, 131, 134
German Federation of Trade Unions, 135
German industries: effective protection of, 138; nominal protection of, 138; subsidies to, 139–40. *See also* Federation of German Industry; German agriculture: public subsidies to
German model (Kiel Institute of World Economics), 137–45; closure assumptions, 141–42; exogenous shocks, 141; government budget balance, 140; specification of, 137–38, 140
Giersch, H., 36, 147
Global Agricultural Trade Study, 24
Grain stocks. *See* World grain stocks

Haidacher, R., 283, 287
Hansen, T., 337
Harbeler, G., 18
Harrison, G., 4, 58, 59, 61, 330, 332, 336, 337, 347, 358
Hathaway, D., 346
Hawke, R., Australian prime minister, 294, 295, 315
Hayami, Y., 156, 177, 180, 186
Heckscher-Ohlin general equilibrium model, 36, 105
Hertel, T., 3, 52, 53, 54, 260, 278, 279, 283, 287
Hertel model, U.S., 264–78; base period, 264–66; behavioral assumptions, 266–67; data base, 278–82; export demand elasticities, 268; factor mobility assumptions, 269; farm production structure, 285; general structure, 277; household demand elasticities, 288; input substitution elasticities, 284; livestock feeds, fea-

tures of, 267, 286; modeling of livestock feeds, 287; nonfarm production technology, 286; price/policy wedges, 278, 280–81; savings and investment, 279, 282; sectors, 276; treatment of set-asides in, 268–69
Heston, A., 130
Hicks (and Harrod) neutral technical change, 230
Higgs, P., 4, 55, 56, 57, 58, 293, 318
Huang, K., 283, 287
Hutt, W., 19

IIASA model, 269
Impact Project Centre, Australia, 296
Import protection as tax on exports, 18–23, 97–98
Imports and welfare, 19
Industries Assistance Commission (IAC), Australia, 297, 318
INTERLINK model, OECD, 121

Japanese agriculture: degree of self-sufficiency, 178, 197 n.2; full-time/part-time farmers, 183, 197 n.1; partial equilibrium models of, 181. *See also* Agricultural liberalization: in Japan; Agricultural protection: in Japan; Vincent model: Japan
Japanese Food Agency, 180
Japanese Livestock Industry Promotion Corporation, 180
Japanese Ministry of Agriculture, Forestry, and Fisheries, 180
Japanese trade imbalance, cause of, 193. *See also* Agricultural protection: in Japan, effects on trade surplus
Johansen, L., 277, 279, 296
Johnson, H., 341, 347
Jones, R., 83
Jorgenson, D., 283
Judd, K., 71
Juttemeier, K., 130

Keidanren, 11, 40
Keller, W., 264, 277, 279, 283
Kennedy Round: subsequent tariff levels, 338. *See also* General Agreement on Tariffs and Trade
Kiel Institute of World Economics, 36, 130, 136. *See also* German model
Kilkenny, M., 222
Kirkpatrick, G., 125, 143, 145
Klau, F., 113
Klepper, G., 137
Korean agricultural protection. *See* Agricultural protection: in Korea
Korean industrialization phase, 159
Korean War, 160
Kravis, I., 130
Krishna, V., 357
Krueger, A., 65

Lederer, T., 293
Legg, W., 96
Less developed countries (LDCs): agriculture taxes, 65; debt problems, 24; effective protection for agriculture, 68–69, 75; effective protection for industry, 68; GDP by sector, 69; GNP per capita, 69; industry subsidies, 65; trade taxes, 68. *See also* Less developed countries, responses to; Loo and Tower model, LDCs; Valdés and Zietz model, results for LDCs
Less developed countries, responses to: higher foreign aid, 73; higher government revenues, 73; higher world agricultural prices, 74–79 (*see also* Agricultural liberalization: in industrial countries); trade versus aid, 74–79
Leutwiller, F., 18
Livestock Industry Promotion Corporation, Japan, 180
Lloyd, P., 295
Long, O., 18
Loo, T., 2, 24, 26, 27, 28, 29, 30, 31, 49
Loo and Tower model, LDCs, 67–92;

analytical description, 83–90; closure alternatives, 66, 71–73; country composition of, 66–67, 91; geometric representation, 80–83; labor supply in, 67; parameter values, 90; resource shifts in and differential ERPs, 81–83; schematic representation, 72
Lutz, E., 181

McFadden, D., 277
McMillan, J., 356
Mansholt plan, 96
Manufacturing assistance, Australia, 295; by sector, 319–20; effects of removal, 302, 305–6, 310
Marginal cost of raising aid, 78. *See also* Marginal welfare cost of taxation
Marginal welfare cost of taxation: in developing countries, 27, 71; importance in Loo and Tower model, 76–77; in the United States, 71
Markusen, J., 337
Marris, S., 49, 50, 203, 205
Marris model, U.S., 203, 205
Maskin, E., 357
Meagher, G., 296
Ministry of Agriculture, Forestry, and Fisheries, Japan, 180
Mittelstädt, A., 113
Monetary compensation amounts, 106, 118, 121. *See also* Common Agricultural Policy: instruments of
Moreaux, M., 358
Muelbauer, J., 122
Multifibre Arrangement, 138

Nash, J., 337, 344
Nash Equilibrium (NE), 331–58 passim
Nash games, 352. *See also* Nash Equilibrium
Nash solution, 344–45, 365 n.4. *See also* Nash Equilibrium
NATO, 346
Nominal rate of protection: for Australian industries, 319–20; defined, 178; for East Asian agriculture, 157–58; for German industries, 138; for Japanese agriculture, 179; limitations of, 157–58; relationship to producer subsidy equivalent, 179

O'Mara, P., 181
ORANI model, Australia, 161, 182, 295–317; closure, 300, 317; exogenous variables, 316–17; NAGA module, 296; numeraire, 300; treatment of home consumption pricing, 320–25; typicalized data base, 296
Organization for Economic Cooperation and Development (OECD), 22, 23, 57, 94, 95, 96, 99, 107, 120, 121, 135, 141, 157, 173, 175, 178, 180, 228, 287

Pareto efficient. *See* Pareto improvement
Pareto improvement, 345, 356, 357
Parmenter, B., 296
Payment in kind (PIK), U.S. farmers, 263. *See also* Agricultural subsidies, U.S.
Pearson, K., 296
Power of tariff. *See* Tariff, power of
Prisoner's Dilemma, 354, 356
Producer subsidy equivalents (PSEs): defined, 170 n.3, 197 n.3, 228; in Asian agriculture, 157; in EC agriculture, 107–8, 120; in German agriculture, 141; in U.S. agriculture, 225
Protection as a tax. *See* Import protection as tax on exports

Quantitative import barriers, Japan: effect of exchange rate on, 180; tariff equivalent of, 180

Rapaport, A., 344
Reagan, R., U.S. president, 45
Repeated games, 357
Robinson, S., 3, 46, 47, 50, 51, 52, 54, 222, 283
Robinson et al. model, U.S., 229–57; agricultural performance in, 237; agricultural sectors, 225; base run, 235–37; export demand elasticities, 256 n.12; export supply elasticities, 253–54; foreign trade, 230–31; government stock demand, 229; land supply elasticities, 229, 256 n.10; macroeconomic closure, 233–34; macroeconomic scenario, 236; numeraire, 232; parameters, 235; PSE rates in, 237 (*see also* Producer subsidy equivalents); responsiveness to world prices, 245–46, 252–54; resource pull effects in, 232; sector detail, 255; sector value added, 235; trade balance constraint, 233; trade shares, 235
Roningen, V., 251, 268, 277
Rutström, E., 330, 332, 337, 347

Schatz, K., 137
Schumacher, B., 122
Sector protection, Australia: nominal rates of, 318–20; subsidy equivalents in agriculture, 297, 321–23
Seeley, R., 268, 269
Set-aside programs, U.S., 278–79; treatment of in Hertel model, 279; treatment of in Robinson et al. model, 239–43, 256 n.10
Shoven, J., 71
Sivesind, C., 213, 218
Sjaastad, L., 19, 23, 97
Spencer, J., 99
Static versus dynamic gains, 17. *See also* Dynamic gains
Strategic self-interest, 333
Strategic trade game, 334; dominant strategy defined, 334; payoffs, 335; specification of, 334
Stern, R., 122, 213
Stoeckel, A., 3, 32, 36, 37, 38, 94, 95, 96, 98, 99, 101, 102, 105, 106, 107, 113, 117, 121, 122, 123
Stuart, C., 71
Sugar industry support, U.S., 262
Sullivan, J., 251, 268, 277
Summers, R., 130
SWOPSIM model, U.S., 290 n.2
Szczepanik, E., 96

Tariff, power of: definition, 170 n.3
Thatcher, M., U.K. prime minister, 205
Thompson, R., 260
Thorpe, S., 36, 95, 98, 99, 102, 105, 106, 107, 113, 117, 121, 122, 123
Tokyo Round, 145. *See also* General Agreement on Tariffs and Trade
Tower, E., 2, 24, 26, 27, 28, 29, 30, 31, 49, 64, 93. *See also* Loo and Tower model, LDCs
Trade mandate study, OECD, 11, 36
Trade war, agricultural
—between the EC and the United States, 338–45; production effects, 342–43; trade effects, 345; welfare payoffs, 340
—escalation of war between the EC and the United States: alternative instruments, 351–54; alternative payoffs, 348–51; effects of, 347–48, 361–64
—types of, 331–32
Treaty of Rome, 117, 128, 131. *See also* German agriculture
Trivial equilibrium, 358. *See also* Nash Equilibrium
Tsigas, M., 260, 278, 279, 283
Tumlir, J., 12
Tyers, R., 24, 25, 26, 36, 60, 99, 131, 181, 251, 359, 360
Tyers-Anderson model of world agricultural liberalizaton: EC-U.S. payoffs,

359–60; results for country groups, 24–25; results for LDCs, 92 n.6

United Nations, 121
Uruguay Round, 1, 10, 145, 147, 243, 295, 342, 346; U.S. proposals, 45, 57. *See also* General Agreement on Tariffs and Trade
U.S. agricultural liberalization
—effects of in Hertel model, 270–90; on capital and land costs, 290; compensation of losers, 274; on prices, 270–71; on quantities, 272–73; on welfare, 274–75. *See also* Hertel model, U.S.
—effects of in Robinson et al. model, 239–55; all subsidies terminated, 248–50; multilateral liberalization, 251–52; relaxing land constraints, 239–43; removing border protection, 243–46; removing domestic subsidies, 247–48; unilateral liberalizaton, 250. *See also* Robinson et al. model, U.S.
U.S. agricultural subsidy removal. *See* Agricultural subsidies, U.S.: removal of
U.S. agriculture: budget support for, 205–7; share of budget deficit, 205. *See also* Agricultural subsidies, U.S.
U.S. Conservation Reserve Program, 263
U.S. Council of Economic Advisers, 262
U.S. Department of Agriculture (USDA), 55, 57, 99, 157, 178, 225, 228, 268, 293
U.S. Farm Bill: of 1981, 263; of 1985, 50, 224, 227, 237, 240, 241, 243, 260, 263, 266
U.S. Farm Credit System, 266
U.S. Farmer's Home Administration, 266
U.S. Food Security Act 1985, 206, 227
Valdés and Zietz model, results for LDCs, 92 n.6
Vincent, D., 3, 6, 41, 42, 43, 150, 173, 182
Vincent model
—Japan, 182–99; border protection shocks, 186, 198 n.12; closure options, 183; expenditure elasticities, 197 n.8; export demand elasticities, 197 n.9; Frisch parameter, 197 n.8; import substitution elasticities, 197 n.7; labor market, treatment of, 183; numeraire, 184; rural land, treatment of, 182–83; sectors of, 182; substitution elasticities, 197 n.7; theoretical structure, 182–84
—Korea, 161–71; closure assumptions, 164–66; economywide constraints, 161; factor substitution elasticities, 170 n.7; household demands, 170 n.11; import substitution elasticities, 170 n.7; labor occupations, 162; land types, 170 n.8; numeraire, 163; output supply elasticities, 171 n.15; returns to land, 171 n.16; sectors, 161, 165–66; theoretical structure, 162; wage assumptions, importance of, 168

Waelbroeck, J., 25
Wainio, J., 251, 268, 277
Wage rigidity and cost of protection in EC, 98. *See also* European Community: labor market rigidities in
Walker, A., 179
Walrasian model, 142, 143, 229, 232
Watson, A., 295
Weiss, F., 137
Welfare gains from reducing distortions, 224
Wenninger, J., 213, 218
Whalley, J., 59, 60, 61, 71, 122, 330, 331

Whalley model, world, 332, 334, 338, 347
Wigle, R., 330, 337
Winters, L., 25, 95, 99
World Bank, 2, 65, 69, 205
World grain stocks, 263; production-consumption imbalances in, 262

Zeitsch, J., 287

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